Foreword

This soil survey contains information that can be used in land-planning programs in the survey area. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

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Soil Survey of

Asotin County Area, Washington,

Parts of Asotin and Garfield Counties

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Washington State Department of Natural Resources and Washington State University, Agricultural Research Center

General Nature of the Survey Area

ASOTIN COUNTY AREA is in the southeastern part of Washington (fig. 1). It has a total area of 370,820 acres, or about 580 square miles. The population of Asotin County was 13,780 in 1984.

The survey area is bounded on the east and north by the Snake River, on the south by Oregon, and on the west by Garfield County. The Blue Mountains merge to the north with a tilted, elevated plateau that is deeply dissected by rivers and streams, forming steep-sided and precipitous canyon walls. Elevation ranges from about 750 feet along the banks of the Snake River, in the northwestern part of the survey area, to 5,010 feet on the top of Big Butte.

Soil scientists have determined that there are about 59 different kinds of soil in the survey area. The soils have a wide range in texture, depth, natural drainage, and other characteristics. Water erosion is the major soil-related problem. Measures that control erosion minimize the sedimentation of streams and thus improve the quality of the water available for municipal use, for recreation, and for fish and wildlife.

Agriculture is the main economic enterprise in the survey area. About 22.6 percent of the acreage is nonirrigated cropland, 0.4 percent is irrigated cropland, 3 percent is pasture or hayland, 64 percent is rangeland, and 8 percent is grazeable woodland. Nonirrigated areas are used mainly for wheat, barley, grass for seed, or hay. Irrigated areas are used mainly for orchard crops, vegetables, hay, or pasture.

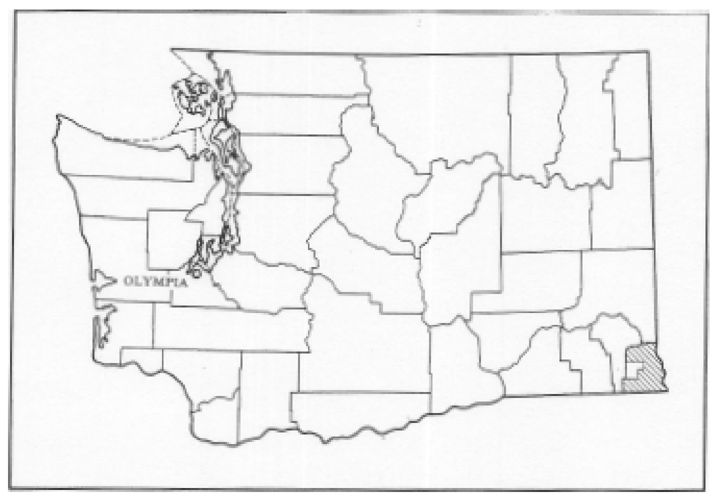

Figure 1.-Location of the Asotin County area in Washington.

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

The Rocky Mountains partly shield the survey area from strong arctic winds. As a result, winters are generally not too severe, though they are cold. In summer, Pacific Ocean winds are partly blocked. Days are hot, but nights are fairly cool. In all but the mountainous areas, the amount of precipitation is scant. During the cooler periods, however, many areas receive enough rainfall for nonirrigated small grain and rangeland. The snowpack accumulation at high elevations supplies irrigation water for intensive agriculture on some of the lowlands.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Anatone, Washington, and Lewiston, Idaho, in the period 1951 to 1978. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 29 degrees F at Anatone and 35 degrees at Lewiston and the average daily minimum temperature is 22 degrees at Anatone and 29 degrees at Lewiston. The lowest temperature on record, which occurred at Anatone on December 30, 1968, is -32 degrees. In summer, the average temperature is 62 degrees at Anatone and 71 degrees at Lewiston and the average daily maximum temperature is about 81 degrees. The highest recorded temperature, which occurred at Lewiston on August 4, 1961, is 115 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 21 inches at Anatone and 13 inches at Lewiston. About 50 percent of this precipitation usually falls in the period April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall during the period of record was 2.24 inches at Anatone on December 23, 1964. Thunderstorms occur on about 16 days each year.

The average seasonal snowfall is about 68 inches at Anatone and 18 inches at Lewiston. The greatest snow depth at any one time during the period of record was 38 inches at Anatone and 16 inches at Lewiston. On an average of 35 days at Anatone and 9 days at Lewiston, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 80 percent of the time possible in summer and 25 percent in winter. The prevailing wind is from the west. Average windspeed is highest, 10 miles per hour, in spring.

History and Development

The Lewis and Clark Expedition is thought to have gone through Asotin on the return trip from the Pacific in 1806. Trappers and hunters were common in the survey area after 1811.

By 1861, there were a few permanent residents and farm settlements were as many as 150 miles apart. At this time, Pearcy's Ferry operated between Lewiston, Idaho, and Clarkston, Washington. Frame buildings, small water-powered sawmills, and livestock were becoming common in the survey area. The early settlements were around the edge of forested areas, near supplies of water and wood. The land along the Snake River was still considered Indian land. The first post office in the survey area was opened in Anatone on January 14, 1878.

Asotin County was once part of Walla Walla County. It was organized as a separate county in the fall of 1883. The town of Asotin was selected as the county seat. By 1885, the population of the county was about 1,500 and about 5,550 acres was cultivated. Between 1883 and 1885, the raising of livestock was the main farm enterprise. The crops grown in the county were used mainly as livestock feed.

During the 1880's, steamboat landings were built in Asotin County, thus providing the opportunity to transport grain crops. These crops became a more important part of the local economy by the early 1900's (7). Around 1886, a project was started to bring water from Asotin Creek to be used for irrigating orchards in the vicinity of Clarkston. A high-line canal was constructed in 1906.

Water Supply

Most of the water used in the survey area is supplied by wells. The average well depth is about 600 feet, but some of the wells are shallower. The municipal wells owned by Clarkston General Water Supply are 793 to 1,340 feet deep. A few irrigation projects in the survey area draw water directly from rivers and streams.

The Columbia River Basalt Group generally controls the availability of ground water. It occurs as plateau-type layers that dip to the northeast. The ground water flows in that general direction. The location of aquifers depends on the series of fracture zones at the interfaces of many of the basalt layers.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge gradually into one another as their characteristics gradually change. To construct an accurate map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The soils or miscellaneous areas making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils or miscellaneous areas can be identified on the map. Likewise, areas that are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The general map units in this survey have been grouped for broad interpretive purposes. The broad groups and the map units in each group are described on the following pages.

Map Unit Descriptions

Soils on Terraces and Terrace Escarpments

These soils make up about 4 percent of the survey area. They are gently sloping to very steep, very deep, and well drained and somewhat excessively drained. They formed in loess, glaciofluvial deposits, and old alluvial sand and gravel having minor amounts of eolian material in the upper part. The native vegetation is mainly grasses. Elevation is 750 to 1,300 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

These soils are used mainly as nonirrigated cropland, irrigated cropland, homesites, or rangeland.

1. Chard-Dallesport

Very deep, well drained and somewhat excessively drained, gently sloping to very steep soils; on terraces and terrace escarpments

This map unit is mainly in the northeastern part of the survey area. Slopes are 2 to 60 percent. The native vegetation is mainly grasses. Elevation is 750 to 1,300 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

This map unit makes up about 4 percent of the survey area. It is about 70 percent Chard soils, 9 percent Dallesport soils, and 21 percent soils of minor extent.

Chard soils are on terraces and terrace escarpments. They are well drained. They formed in loess and glaciofluvial deposits. Typically, the surface layer is loam. The upper part of the subsoil is fine sandy loam, and the lower part to a depth of 60 inches or more is sandy loam.

Dallesport soils are on terraces and terrace escarpments. They are somewhat excessively drained. They formed in old alluvial sand and gravel having minor amounts of eolian material in the upper part. Typically, the surface layer is very cobbly sandy loam or very gravelly sandy loam. The subsoil is very gravelly sandy loam. The upper part of the substratum is very gravelly sand, and the lower part to a depth of 60 inches or more is extremely gravelly sand.

Of minor extent in this unit are Ewall soils on terraces, Nims and Weissenfels soils on plateaus and hillslopes, and Lickskillet and Schuelke soils on canyon walls and shoulder slopes.

This unit is used mainly for nonirrigated crops, irrigated crops, or homesite development. The main management concerns in areas of nonirrigated cropland are the hazard of water erosion, the slope, low annual precipitation, a low available water capacity, and the very cobbly surface layer in the Dallesport soils. The main management concerns in areas of irrigated cropland are the hazard of water erosion, the slope, the low available water capacity, and the very cobbly surface layer in the Dallesport soils. The main limitations on homesites are large stones on the

Dallesport soils and the slope. The main limitations on sites for septic tank absorption fields are a poor filtering capacity and the slope. The production of forage is limited by the low available water capacity in the Dallesport soils.

Soils on Canyon Walls, Foot Slopes, Slump Blocks, and Shoulder Slopes

These soils make up about 56 percent of the survey area. They are gently sloping to very steep, shallow to very deep, and well drained. They formed in loess, colluvium, and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses and shrubs. Elevation is 800 to 4,100 feet. The average annual precipitation is 12 to 25 inches, the average annual air temperature is 48 to 52 degrees F, and the average frost-free period is 100 to 190 days.

These soils are used mainly as rangeland or wildlife habitat.

2. Lickskillet-Schuelke-Bolicker

Shallow to very deep, well drained, gently sloping to very steep soils in the 12- to 15-inch precipitation zone; on canyon walls, foot slopes, slump blocks, and shoulder slopes

This map unit is in the northern part of the survey area. Slopes are 3 to 120 percent. The native vegetation is mainly grasses. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

This map unit makes up about 19 percent of the survey area. It is about 24 percent Lickskillet soils, 20 percent Schuelke soils, 12 percent Bolicker soils, and 44 percent soils of minor extent.

Lickskillet soils are on south-facing canyon walls and shoulder slopes (fig. 2). They are shallow. They formed in colluvium derived from loess and material weathered from basalt. Slopes are 3 to 120 percent. Typically, the surface layer is very stony loam. The subsoil is very cobbly loam, which is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches.

Schuelke soils are on south-facing canyon walls. They are moderately deep. They formed in loess, colluvium, and slope alluvium derived from weathered basalt. Slopes are 3 to 90 percent. Typically, the upper part of the surface layer is very stony silt loam, and the lower part is very cobbly silt loam. The subsoil is very cobbly clay loam and extremely cobbly clay loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches.

Bolicker soils are on north-facing canyon walls, slump blocks, and foot slopes. They are very deep. They formed in loess over basaltic colluvium. Slopes are 15 to 90 percent. Typically, the surface layer is silt loam. The upper part of the subsoil is silt loam, and the lower part to a depth of 60 inches or more is very cobbly loam.

Of minor extent in this unit are Asotin and Nansene soils and Rock outcrop on canyon walls; Alpowa soils on canyon walls and foot slopes; Chard, Ewall, and Dallesport soils on terraces and terrace escarpments; Nims and Weissenfels soils on plateaus; and Veazie, Bridgewater, Veazie Variant, and Joseph soils on flood plains, low terraces, and alluvial fans.

This unit is used mainly as rangeland or wildlife habitat. The production of forage is limited by low annual precipitation and a very low or low available water capacity in the Lickskillet and Schuelke soils. The production of forage on the Bolicker soils is about 1,200 pounds per acre in an average year.

3. Laufer-Thiessen-Matheny

Shallow to very deep, well drained, strongly sloping to very steep soils in the 15- to 18-inch precipitation zone; on canyon walls, slump blocks, and foot slopes

This map unit is in the southeastern and central parts of the survey area. Slopes are 10 to 120 percent. The native vegetation is mainly grasses. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

This map unit makes up about 20 percent of the survey area. It is about 21 percent Laufer soils, 13 percent Thiessen soils, 6 percent Matheny soils, and 60 percent soils of minor extent.

Laufer soils are on south-facing canyon walls. They are shallow. They formed in loess, colluvium, and slope alluvium derived from weathered basalt. Slopes are 30 to 120 percent. Typically, the surface layer is very stony clay loam. The upper part of the subsoil is very cobbly clay loam. The lower part is extremely cobbly clay loam, which is underlain by basalt at a depth of about 15 inches. The depth to basalt ranges from 10 to 20 inches.

Thiessen soils are on south-facing canyon walls. They are moderately deep. They formed in loess, colluvium, and slope alluvium derived from weathered basalt. Slopes are 30 to 90 percent. Typically, the surface layer is very stony silt loam. The upper part of the subsoil is very cobbly clay loam. The lower part is

Figure 2.-An area of the Lickskillet-Schuelke-Bolicker general soil map unit. Lickskillet and Schuelke soils are on south-facing canyon walls, and Bolicker soils are on north-facing slopes.

extremely cobbly clay loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches.

Matheny soils are on north-facing canyon walls, slump blocks, and foot slopes. They are deep and very deep. They formed in colluvium and slope alluvium derived from weathered basalt and in loess and some volcanic ash. Slopes are 10 to 90 percent. Typically, the surface layer is silt loam or stony silt loam. The upper part of the subsoil is very cobbly clay loam. The lower part is extremely cobbly loam, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to more than 60 inches.

Of minor extent in this unit are Limekiln, Thiessen Variant, Rockly, Linville, Limekiln Variant, Matheny Variant, Tyee, and Tyee Variant soils on canyon walls; Stember soils on plateaus and shoulder slopes; Chard and Ewall soils on terraces and terrace escarpments; Pataha, Peola, and Neissenberg soils on plateaus; and Veazie, Bridgewater, Veazie Variant, and Joseph soils on flood plains, low terraces, and alluvial fans.

This unit is used mainly as rangeland or wildlife habitat. The production of forage is limited by a very low or low available water capacity in the Laufer and Thiessen soils. The production of forage on the Matheny soils is about 1,500 pounds per acre in an average year.

4. Gwinly-Mallory-Lawyer

Shallow to very deep, well drained, gently sloping to very steep soils in the 18- to 25-inch precipitation zone; on canyon walls and shoulder slopes

This map unit is in the southern and central parts of the survey area. Slopes are 3 to 120 percent. The native vegetation is mainly grasses and shrubs. Elevation is 1,400 to 4,100 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 100 to 135 days.

This map unit makes up about 17 percent of the survey area. It is about 36 percent Gwinly soils, 26 percent Mallory soils, 13 percent Lawyer soils, and 25 percent soils of minor extent.

Gwinly soils are on south-facing canyon walls and shoulder slopes. They are shallow. They formed in loess and colluvium derived from weathered basalt. Slopes are 3 to 120 percent. Typically, the surface layer is very stony silt loam. The upper part of the subsoil is very cobbly clay loam. The lower part is extremely cobbly clay, which is underlain by basalt at a depth of about 15 inches. The depth to basalt ranges from 10 to 20 inches.

Mallory soils are on south-facing canyon walls and shoulder slopes. They are moderately deep. They formed in loess, slope alluvium, and colluvium derived from weathered basalt. Slopes are 3 to 90 percent. Typically, the upper part of the surface layer is very stony silt loam or stony silt loam, and the lower part is very cobbly clay loam. The subsoil is very cobbly and extremely cobbly clay, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches.

Lawyer soils are on north-facing canyon walls. They are deep and very deep. They formed in loess and colluvium derived from weathered basalt. Slopes are 30 to 90 percent. Typically, the upper part of the surface layer is stony silt loam or silt loam, and the lower part is gravelly silt loam. The upper part of the subsoil is very gravelly clay loam. The lower part is *very* cobbly clay loam and very cobbly clay, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to more than 60 inches.

Of minor extent in this unit are Rockly and Tamming soils on south-facing canyon walls; DeMasters, Harlow. Getaway, and Snell soils on north-facing canyon walls; Cloverland soils on mountain plateaus, benches, and north-facing hillslopes; Bridgewater, Veazie, Veazie Variant, and Bridgewater Variant soils on alluvial fans, flood plains, and low terraces; and Neconda, Ferdinand, and Geoconda soils on plateaus and hillslopes.

This unit is used mainly as rangeland or wildlife habitat. The production of forage is limited by a low available water capacity in the Gwinly and Mallory soils. The production of forage on the Lawyer soils is about 2,100 pounds per acre in an average year.

Soils on Plateaus and Hillslopes

These soils make up about 26 percent of the survey area. They are gently sloping to steep, moderately deep to very deep, and moderately well drained and well drained. They formed in loess, slope alluvium, and colluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 1,200 to 4,100 feet. The average annual precipitation is 12 to 22 inches, the average annual air temperature is 44 to 51 degrees F, and the average frost-free period is 90 to 155 days.

These soils are used mainly as nonirrigated cropland, hayland and pasture, or wildlife habitat.

5. Nims-Weissenfels-Olical

Moderately deep and very deep, well drained and moderately well drained, gently sloping to moderately steep soils in the 12- to 15-inch precipitation zone; on plateaus and hillslopes

This map unit is in the northern part of the survey area. Slopes are 3 to 30 percent. The native vegetation is mainly grasses. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

This map unit makes up about 11 percent of the survey area. It is about 41 percent Nims soils, 27 percent Weissenfels soils, 7 percent Olical soils, and 25 percent soils of minor extent.

Nims soils are on plateaus and hillslopes. They are moderately deep and well drained. They formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 30 percent. Typically, the surface layer and the upper part of the subsoil are silt loam. The lower part of the subsoil is very cobbly and very gravelly loam, which is underlain by basalt at a depth of about 35 inches. The depth to basalt ranges from 20 to 40 inches.

Weissenfels soils are on plateaus and hillslopes. They are moderately deep and moderately well drained. They formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 30 percent. Typically, the surface layer is silt loam. The upper part of the subsoil is silty clay and silty clay loam. The next part is silt loam. The lower part is very gravelly loam, which is underlain by basalt at a depth of about 37 inches. The depth to basalt ranges from 25 to 40 inches.

Olical soils are on plateaus and hillslopes. They are very deep and well drained. They formed in loess. Slopes are 3 to 30 percent. Typically, the surface layer is silt loam. The subsoil to a depth of 60 inches or more also is silt loam.

Of minor extent in this unit are Spofford soils on plateaus, Nansene soils on north-facing hillsides and canyon walls, Lickskillet and Schuelke soils on canyon walls and shoulder slopes, and Bolicker and Asotin soils on north-facing canyon walls.

This unit is used mainly as nonirrigated cropland or wildlife habitat. The main management concerns in areas of nonirrigated cropland are low annual precipitation, a hazard of water erosion, a low available water capacity in the Nims soils, a high content of sodium in the subsoil of the Weissenfels soils, and the slope. Because of the low annual precipitation, a wheat-fallow rotation is used.

6. Stember-Pataha-Neissenberg

Moderately deep, well drained and moderately well drained, gently sloping to strongly sloping soils in the 15- to 18-inch precipitation zone; on plateaus and hillslopes

This map unit is in the central part of the survey area. Slopes are 3 to 30 percent. The native vegetation is mainly grasses. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

This map unit makes up about 4 percent of the survey area. It is about 35 percent Stember soils, 26 percent Pataha soils, 15 percent Neissenberg soils, and 24 percent soils of minor extent.

Stember soils are on plateaus. They are well drained. They formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 30 percent. Typically, the upper part of the surface layer is silt loam, and the lower part is gravelly silt loam. The upper part of the subsoil is very cobbly silt loam. The lower part is very cobbly loam, which is underlain by basalt at a depth of about 24 inches. The depth to basalt ranges from 20 to 30 inches.

Pataha soils are on plateaus. They are well drained. They formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 15 percent. Typically, the surface layer and the upper part of the subsoil are silt loam. The lower part of the subsoil is gravelly silt loam, very cobbly loam, and very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches.

Neissenberg soils are on plateaus and hillslopes. They are moderately well drained. They formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 15 percent. Typically, the surface layer is silt loam. The upper part of the subsoil is silty clay. The next part is silty clay loam. The lower part is very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches.

Of minor extent in this unit are Spofmore and Catheen soils on plateaus and hillslopes; Limekiln soils on shoulder slopes; Laufer, Thiessen, and Thiessen Variant soils on canyon walls; and Matheny and Linville soils on north-facing canyon walls.

This unit is used mainly as nonirrigated cropland, hayland and pasture, or wildlife habitat. The main management concerns in areas of nonirrigated cropland are stones on or near the surface, the hazard of water erosion, a low available water capacity in the Stember soils, and a high content of sodium in the subsoil of the Neissenberg soils. Because of the low annual precipitation, a 3-year rotation of winter wheat, spring barley, and fallow is used.

7. Peola-Neissenberg-Catheen

Moderately deep and very deep, well drained and moderately well drained, gently sloping to steep soils in the 15- to 18-inch precipitation zone; on plateaus and hillslopes

This map unit is in the northwestern part of the survey area. Slopes are 3 to 40 percent. The native vegetation is mainly grasses. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

This map unit makes up about 2 percent of the survey area. It is about 34 percent Peola soils, 31 percent Neissenberg soils, 21 percent Catheen soils, and 14 percent soils of minor extent.

Peola soils are mainly on plateaus and hillslopes. They are moderately deep and well drained. They formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 40 percent. Typically, the surface layer and the upper part of the subsoil are silt loam. The lower part of the subsoil is very cobbly loam, which is underlain by basalt at a depth of about 36 inches. The depth to basalt ranges from 30 to 40 inches.

Neissenberg soils are mainly on plateaus and hillslopes. They are moderately deep and moderately well drained. They formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 40 percent. Typically, the surface layer is silt loam. The upper part of the subsoil is silty clay. The next part is silty clay loam. The lower part is very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches.

Catheen soils are on plateaus and hillslopes. They are very deep and well drained. They formed in loess. Slopes are 3 to 30 percent. Typically, the surface layer is silt loam. The subsoil to a depth of 60 inches or more is silty clay loam.

Of minor extent in this unit are Spofmore and Alpowa Variant soils on plateaus, Limekiln and Stember soils on shoulder slopes, Laufer and Thiessen soils on canyon walls, and Matheny and Linville soils on north-facing canyon walls.

This unit is used mainly as nonirrigated cropland, pasture, or wildlife habitat. The main management concerns in areas of nonirrigated cropland are a high content of sodium in the subsoil of the Neissenberg soils, the slope, and the hazard of water erosion on slopes of more than 15 percent. The hazard of water erosion is severe. Intensive management is needed. Grasses and legumes should be grown at least half of the time, and a 3-year rotation of winter wheat, spring barley, and fallow should be used during the other half.

8. Neconda-Ferdinand-Powwahkee

Moderately deep and very deep, well drained,. gently sloping to moderately steep soils in the 17- to 20-inch precipitation zone; on plateaus and hillslopes

This map unit is in the central part of the survey area. Slopes are 3 to 30 percent. The native vegetation is mainly grasses. Elevation is 3,000 to 3,600 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 130 days.

This map unit makes up about 5 percent of the survey area. It is about 41 percent Neconda soils, 18 percent Ferdinand soils, 12 percent Powwahkee soils, and 29 percent soils of minor extent.

Neconda soils are on plateaus (fig. 3). They are moderately deep. They formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 15 percent. Typically, the surface layer is silty clay loam or silt loam. The upper part of the subsoil is silty clay loam. The next part is gravelly clay. The lower part is very cobbly loam, which is underlain by basalt at a depth of about 37 inches. The depth to basalt ranges from 30 to 40 inches.

Ferdinand soils are on plateaus. They are moderately deep. They formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 8 percent. Typically, the surface layer is silty clay loam. The upper part of the subsoil is very gravelly silty clay loam. The next part is very gravelly silty clay. The lower part is very cobbly clay loam, which is underlain by basalt at a depth of about 23 inches. The depth to basalt ranges from 20 to 30 inches.

Powwahkee soils are on plateaus and hillslopes. They are very deep. They formed in loess. Slopes are 3 to 30 percent. Typically, the surface layer is silt loam. The upper part of the subsoil is silty clay loam. The next part is silty clay. The lower part to a depth of 60 inches or more is silty clay loam.

Of minor extent in this unit are Geoconda soils on plateaus and hillslopes, Gwinly and Mallory soils on canyon walls and shoulder slopes, and Lawyer soils on north-facing canyon walls.

This unit is used mainly as nonirrigated cropland, hayland and pasture, or wildlife habitat. The main management concerns in areas of nonirrigated cropland are the hazard of water erosion, a low available water capacity in the Ferdinand soils, and the slope. Growing annual grain helps to control water erosion, results in an efficient use of soil moisture, and increases the rate of water infiltration.

9. Sweitberg-Snell-Sweitberg Variant

Moderately deep and deep, well drained, gently sloping to strongly sloping soils in the 20- to 22-inch precipitation zone; on plateaus

This map unit is in the central and southern parts of the survey area. Slopes are 3 to 15 percent. The native vegetation is mainly grasses. Elevation is 3,000 to 4,100 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 44 degrees F, and the average frost-free period is 90 to 115 days.

This map unit makes up about 4 percent of the survey area. It is about 44 percent Sweitberg soils, 28 percent Snell soils, 7 percent Sweitberg Variant soils, and 21 percent soils of minor extent.

Sweitberg soils are on plateaus. They are moderately deep. They formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 15 percent. Typically, the surface layer is silty clay loam. The upper part of the subsoil is silty clay loam, the next part is silty clay, and the lower part is very cobbly clay, which is underlain by basalt at a depth of about 32 inches. The depth to basalt ranges from 30 to 40 inches.

Snell soils are on plateaus. They are moderately deep. They formed in loess and colluvium derived from weathered basalt. Slopes are 3 to 15 percent. Typically, the upper part of the surface layer is silty clay loam, and the lower part is gravelly silty clay loam. The upper part of the subsoil is gravelly silty clay. The lower part is very gravelly silty clay, which is underlain by basalt at a depth of about 23 inches. The depth to basalt ranges from 20 to 40 inches.

Sweitberg Variant soils are on plateaus. They are deep. They formed in loess and slope alluvium derived

Figure 3.-An area of the Neconda-Ferdinand-Powwahkee general soil map unit on a plateau. Fort Simons Ridge and the Craig Mountains are in the background. They are in Idaho.

from weathered basalt. Slopes are 3 to 15 percent. Typically, the surface layer is silty clay loam. The upper part of the subsoil also is silty clay loam. The next part is silty clay. The lower part is very cobbly clay, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to 60 inches.

Of minor extent in this unit are Harlow and Harlow Variant soils on shoulder slopes and ridgetops, Harlow soils on canyon walls, and DeMasters soils on north-facing canyon walls.

This unit is used mainly as nonirrigated cropland, hayland and pasture, or wildlife habitat. The main management concerns in areas of nonirrigated cropland are the hazard of water erosion, a low available water capacity in the Snell soils, the short frost-free period, wetness in spring, and the slope. The production of forage is limited by a low available water capacity in the Snell soils and by the short frost-free period.

Soils on Mountain Plateaus, Benches, and Hillslopes

These soils make up about 7 percent of the survey area. They are gently sloping to steep, moderately deep and very deep, and moderately well drained and well drained. They formed in loess, slope alluvium and colluvium derived from weathered basalt, and volcanic ash over loess. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

These soils are used mainly as grazeable woodland, hayland and pasture, nonirrigated cropland, or wildlife habitat.

10. Cloverland-Sweiting-Tolo

Moderately deep and very deep, well drained and moderately well drained, gently sloping to steep soils; on mountain plateaus, benches, and hillslopes

This map unit is in the southwestern part of the survey area. Slopes are 3 to 45 percent. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

This map unit makes up about 7 percent of the survey area. It is about 56 percent Cloverland soils, 18 percent Sweiting soils, 21 percent Tolo soils, and 5 percent soils of minor extent.

Cloverland soils are on mountain plateaus, benches, and north-facing hillslopes. They are deep and very deep and are moderately well drained. They formed in loess that has minor amounts of volcanic ash and of slope alluvium derived from weathered basalt. Slopes are 3 to 45 percent. Typically, the surface layer and subsoil are silt loam. Below this is a buried subsoil of silty clay loam. The depth to basalt ranges from 40 to more than 60 inches.

Sweiting soils are on mountain plateaus and benches. They are moderately deep and well drained. They formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 30 percent. Typically, the surface layer is silt loam. The upper part of the subsoil is silty clay loam. The lower part is very cobbly silty clay loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches.

Tolo soils are on northeast-facing mountain plateaus and hillslopes. They are deep and well drained. They formed in a mantle of volcanic ash and in loess and colluvium derived from weathered basalt. Slopes are 3 to 45 percent. Typically, the surface layer and subsoil are silt loam. Below this is a buried soil. The upper part of the buried soil is silt loam, and the lower part is gravelly silty clay loam, which is underlain by basalt at a depth of about 55 inches. The depth to basalt ranges from 40 to 60 inches.

Of minor extent in this unit are Olot, Klicker, Harlow, and Harlow Variant soils on mountain plateaus and benches and Getaway, Harlow, and Snell soils on canyon walls.

This unit is used mainly as grazeable woodland, hayland and pasture, nonirrigated cropland, or wildlife habitat. The main problems affecting timber production and harvesting are the hazard of water erosion, seasonal wetness, snowpack, and plant competition. The production of forage is limited by the short frost-free period and by low fertility in the Tolo soils. The main management concerns in areas of nonirrigated cropland are the hazard of water erosion, wetness in spring, the short frost-free period, the low fertility in the Tolo soils, and the slope.

Soils on Mountainsides, Mountain Plateaus, Canyon Walls, Shoulder Slopes, Benches, and Ridgetops

These soils make up about 7 percent of the survey area. They are gently sloping to very steep, shallow to deep, and well drained. They formed in loess, colluvium, and slope alluvium derived from weathered basalt and in some volcanic ash. The native vegetation is mainly grasses, conifers, and shrubs. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 115 days.

These soils are used mainly as rangeland, grazeable woodland, or wildlife habitat.

11. Harlow-Getaway-Snell

Shallow to deep, well drained, gently sloping to very steep soils on mountainsides, mountain plateaus, canyon walls, shoulder slopes, benches, and ridgetops

This map unit is in the southwestern and southern parts of the survey area. Slopes are 3 to 90 percent. The native vegetation is grasses, conifers, and shrubs. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 115 days.

This map unit makes up about 7 percent of the survey area. It is about 33 percent Harlow soils, 22 percent Getaway soils, 16 percent Snell soils, and 29 percent soils of minor extent.

Harlow soils are on mountain plateaus, benches, canyon walls, shoulder slopes, and ridgetops. They are shallow. They formed in loess, colluvium, and slope alluvium derived from weathered basalt. Slopes are 3 to 90 percent. Typically, the upper part of the surface layer is very stony clay loam, and the lower part is very gravelly clay loam. The subsoil is very cobbly clay loam and extremely cobbly clay, which is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches.

Getaway soils are on mountainsides and canyon walls. They are deep. They formed in loess, in some volcanic ash, and in colluvium and slope alluvium derived from weathered basalt. Slopes are 30 to 90 percent. Typically, the upper part of the surface layer is stony or very stony silt loam, and the lower part is cobbly silt loam. The upper part of the subsoil is very cobbly silty clay loam. The lower part is very cobbly clay loam, which is underlain by basalt at a depth of about 58 inches. The depth to basalt ranges from 40 to 60 inches.

Snell soils are on mountainsides, canyon walls, shoulder slopes, and ridgetops. They are moderately deep. They formed in loess and colluvium derived from weathered basalt. Slopes are 15 to 90 percent. Typically, the upper part of the surface layer is very stony clay loam, and the lower part is very gravelly clay loam. The upper part of the subsoil is very cobbly clay loam. The lower part is extremely cobbly clay, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches.

Of minor extent in this unit are Crackercreek and DeMasters soils on north-facing canyon walls; Gwinly, Mallory, and Tamming soils on south-facing canyon walls; Bridgewater Variant soils on flood plains; and Cloverland and Tolo soils on north-facing hillsides and on plateaus.

This unit is used mainly as grazeable woodland, hayland and pasture, or wildlife habitat. The production of forage is limited by a very low or low available water capacity in the Harlow and Snell soils and the short frost-free period. The main problems affecting timber production and harvesting are the slope, the hazard of water erosion, rock outcrops, and snowpack.

Broad Land Use Considerations

The soils in the survey area vary widely in their potential for major land uses. Approximately 23 percent of the area is used as cropland and 3 percent as hayland or pasture. The major nonirrigated crops are wheat, barley, peas, and grass for seed. About 50 acres of irrigated cropland is used for orchards and 290 acres for vegetables, hay, or pasture.

The nonirrigated cropland and the areas used for hay or pasture are in general soil map units 1, 5, 6, 7, 8, and 9. Some small areas of nonirrigated cropland are in general soil map unit 10. The soils that are used for nonirrigated crops include Chard, Nims, Weissenfels, Olical, Pataha, Stember, Neissenberg, Peola, Neconda, Cloverland, Sweiting, Ferdinand, Powwahkee, Sweitberg, Snell, and Sweitberg Variant soils.

The main limitations in the areas of nonirrigated cropland are the hazard of water erosion, the slope, and a low available water capacity in some soils. Cloverland, Sweiting, Sweitberg, and Sweitberg Variant soils are limited by a short growing season and by wetness in spring. The main limitation in the areas used for hay or pasture is a low available water capacity. General soil map units 9 and 10 are limited by a short growing season.

Chard soils are the major soils used as irrigated cropland in general soil map unit 1. Some small areas on flood plains and terraces adjacent to Alpowa Creek, Asotin Creek, and the Grande Ronde and Snake Rivers also are used for irrigated crops. The main limitations in the areas of irrigated cropland are the hazard of water erosion and the slope. Veazie soils on low terraces and flood plains are limited by the hazard of flooding. Veazie Variant soils on flood plains are limited by a low available water capacity and a seasonal high water table.

Approximately 64 percent of the survey area is used as rangeland. Lickskillet, Schuelke, Bolicker, Laufer, Thiessen, Matheny, Gwinly, Mallory, Lawyer, Harlow, and Snell soils in general soil map units 2, 3, 4, and 11 are used as rangeland. The production of forage for livestock is limited by a low available water capacity. The forage also is grazed by large game animals.

Approximately 8 percent of the survey area is wooded. The woodland is in areas of Cloverland, Sweiting, and Tolo soils in general soil map unit 10 and Getaway soils in general soil map unit 11. The main limitations affecting timber production and harvesting are the hazard of water erosion, seasonal wetness, snowpack, and plant competition in general soil map unit 10 and the slope, the hazard of water erosion, rock outcrops, and snowpack in general soil map unit 11. Most of the woodland is grazed by livestock and by large game animals.

Approximately 2 percent of the survey area is developed for urban uses. The developed areas are in general soil map unit 1. The major soils in this unit are Chard and Dallesport. The main limitations on homesites are large stones in areas of the Dallesport soils and the slope of both soils. The main limitations on sites for septic tank absorption fields are a poor filtering capacity and the slope.

The suitability of the soils in the survey area for recreational development ranges from poor to good, depending on the intensity of the expected use and the properties of the soils. Most areas in general soil map units 1, 5, 6, 7, 8, 9, and 10 are suitable for intensive recreational uses. The main limitations in general soil map units 2, 3, 4, and 11 are the slope and the depth to basalt. They affect landscaping for campgrounds and picnic areas. These map units are suited to extensive recreational areas, such as trails for hiking and horseback riding and hunting areas. Small areas that are suitable for intensive recreational uses are available in most of the general soil map units.

Detailed Soil Map Units

The map units delineated on the detailed maps at the back of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit is given under "Use and Management of the Soils."

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavior divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas in a precise manner.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer or of the underlying layers, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Chard loam, 2 to 5 percent slopes, is a phase of the Chard series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or associations.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Laufer-Thiessen-Rock outcrop complex, 40 to 90 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Ferdinand Variant-Mallory Variant association, 8 to 70 percent slopes, is an example.

This survey includes *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Map Unit Descriptions

1-Alpowa stony silt loam, 15 to 30 percent slopes. This very deep, well drained soil is on foot slopes and on small benches on canyon walls. It formed in loess, colluvium derived from loess, and material weathered from basalt. The native vegetation is mainly grasses. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 190 days.

Typically, the surface layer is dark grayish brown stony silt loam about 8 inches thick. The upper 15 inches of the subsoil is brown very cobbly silt loam. The lower part to a depth of 60 inches or more is light gray and pale brown very cobbly loam. The soil is calcareous below a depth of about 23 inches.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Schuelke very stony silt loam, Bolicker silt loam, and Alpowa soils that have slopes of less than 15 percent or more than 30 percent. The included areas make up about 25 percent of the unit.

This unit is used as rangeland or wildlife habitat. The potential native vegetation is bluebunch wheatgrass and Idaho fescue. If the vegetation is overgrazed, the proportion of the preferred plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred forage plants, such as cheatgrass, other annual bromes, and prickly lettuce, increases. Areas that have an excessive number of undesirable shrubs can be improved by mechanical and chemical treatment or prescribed burning.

This unit is suited to range seeding if a rangeland drill is used. Undesirable plants can be controlled by applying chemicals.

This unit is in capability subclass VIe, nonirrigated.

2-Alpowa Variant silt loam, 3 to 8 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

Typically, the upper 7 inches of the surface layer is dark grayish brown silt loam. The lower 3 inches is dark grayish brown gravelly silty clay loam. The upper 4 inches of the subsoil is grayish brown very cobbly silty clay loam. The lower 8 inches is white very cobbly clay loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 30 inches. The soil is calcareous below a depth of about 14 inches. In some areas the surface layer is cobbly silt loam.

Permeability is moderate. Available water capacity is low. The effective rooting depth is 20 to 30 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Peola silt loam, Neissenberg silt loam, and Alpowa Variant soils that have slopes of more than 8 percent. Also included are areas where basalt is within a depth of 20 inches. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion, the low available water capacity, and the cobbles near the surface. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain results in the efficient use of soil moisture, allows storage of more winter precipitation the following year, and helps to control water erosion. It also increases the rate of water intake if all crop residue is mixed into the tillage layer. An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage is restricted in areas where stones and cobbles are on or near the surface.

Terraces reduce the length of slopes. They help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IVe, nonirrigated.

3-Asotin-Lickskillet-Rock outcrop complex, 40 to 90 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly grasses. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 190 days.

This unit is about 40 percent Asotin silt loam, 25 percent Lickskillet very stony loam, and 15 percent Rock outcrop. The Asotin soil is in slightly concave areas, and the Lickskillet soil and Rock outcrop are in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Bolicker silt loam, Alpowa very stony silt loam, and Lickskillet soils that have slopes of more than 90 percent. The included areas make up about 20 percent of the unit.

The Asotin soil is moderately deep and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown and grayish brown silt loam about 11 inches thick. The upper 8 inches of the subsoil is brown silt loam. The lower 4 inches is very pale brown gravelly silt loam, which is underlain by basalt at a depth of about 23 inches. The depth to basalt ranges from 20 to 40 inches. The soil is calcareous below a depth of about 19 inches.

Permeability is moderate in the Asotin soil. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Lickskillet soil is shallow and well drained. It formed in colluvium derived from loess and in material weathered from basalt. Typically, the surface layer is dark grayish brown very stony loam about 4 inches thick. The subsoil is brown very cobbly loam about 10 inches thick. It is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is moderate in the Lickskillet soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low available water capacity in the Lickskillet soil. The slope and the Rock outcrop limit access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment. Range seeding is not practical because of the slope, the stoniness of the surface layer in the Lickskillet soil, and the Rock outcrop. The slope, the Rock outcrop, the surface stones, and the shallowness of the Lickskillet soil interfere with the installation of fences and watering facilities.

The Asotin soil is in capability subclass VIIe, nonirrigated. The Lickskillet soil is in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

4-Bolicker silt loam, 15 to 30 percent slopes. This very deep, well drained soil is on concave foot slopes and on concave slump blocks on canyon walls. It formed in loess over basaltic colluvium. The native vegetation is mainly grasses. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 190 days.

Typically, the surface layer is dark grayish brown silt loam about 11 inches thick. The upper 18 inches of the subsoil is brown silt loam. The lower part to a depth of 60 inches or more is very pale brown very cobbly loam. The soil is calcareous below a depth of about 29 inches.

Permeability is moderately rapid. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Alpowa stony silt loam and Bolicker soils that have slopes of less than 15 percent or more than 30 percent. Also included are some areas where the depth to basalt is 40 to 60 inches. The included areas make up about 25 percent of the unit.

This unit has few limitations in areas used as rangeland or wildlife habitat. The potential native vegetation is Idaho fescue, bluebunch wheatgrass, and lupine. If the unit is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue and bluebunch wheatgrass, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and prickly lettuce, increases. Areas that have an excessive number of undesirable shrubs can be improved by mechanical treatment, chemical treatment, or prescribed burning.

This unit can be seeded with a single- or double-disk drill, a deep-furrow drill, or a rangeland drill. Undesirable plants can be controlled by summer fallowing prior to seeding or by applying chemicals.

This unit is in capability subclass IVe, nonirrigated.

5-Bolicker-Asotin silt loams, 40 to 90 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly grasses. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 190 days.

This unit is about 40 percent Bolicker silt loam and 35 percent Asotin silt loam. The Bolicker soil is in concave areas, and the Asotin soil is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Nansene silt loam, Schuelke very stony silt loam, Lickskillet very stony silt loam, and Bolicker soils that have slopes of less than 40 percent. Also included are areas of Rock outcrop and areas of Bridgewater extremely stony sandy loam on alluvial fans and flood plains. The included areas make up about 25 percent of the unit.

The Bolicker soil is very deep and well drained. It formed in loess over basaltic colluvium. Typically, the surface layer is dark grayish brown silt loam about 11 inches thick. The upper 18 inches of the subsoil is brown silt loam. The lower part to a depth of 60 inches or more is very pale brown very cobbly loam. The soil is calcareous below a depth of about 29 inches.

Permeability is moderately rapid in the Bolicker soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very severe.

The Asotin soil is moderately deep and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown and grayish brown silt loam about 11 inches thick. The upper 8 inches of the subsoil is brown silt loam. The lower 4 inches is very pale brown gravelly silt loam, which is underlain by basalt at a depth of about 23 inches. The depth to basalt ranges from 20 to 40 inches. The soil is calcareous below a depth of about 19 inches.

Permeability is moderate in the Asotin soil. Available water capacity also is moderate. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit has few limitations in areas used as rangeland or wildlife habitat. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is Idaho fescue and bluebunch wheatgrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue and bluebunch wheatgrass, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment. Range seeding generally is not practical because of the slope. The cobbles in the Bolicker soil and the slope of both soils interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIe, nonirrigated.

6-Bridgewater extremely stony sandy loam, 0 to 15 percent slopes. This very deep, well drained soil is on flood plains, low terraces, and alluvial fans. It is subject to rare flooding. It formed in alluvium. The native vegetation is mainly shrubs and grasses. Elevation is 800 to 2,500 feet. The average annual precipitation is 12 to 19 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 120 to 150 days.

Typically, the upper 8 inches of the surface layer is dark grayish brown extremely stony sandy loam about 8 inches thick. The lower 22 inches is dark grayish brown extremely cobbly sandy loam. The underlying material to a depth of 60 inches or more is brown extremely cobbly loamy sand. In some areas the surface layer is extremely stony or very stony loam.

Permeability is moderately rapid in the surface layer and very rapid in the underlying material. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Bridgewater soils that are occasionally flooded. Also included are soils that have a surface layer of extremely stony loamy sand, silt loam, or loam. The included areas make up about 20 percent of the unit.

This unit is used for rangeland, homesite development, or wildlife habitat. The production of vegetation is limited by the low available water capacity. The potential native vegetation is bluebunch wheatgrass and basin wildrye. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and basin wildrye, decreases and the proportion of the less preferred forage plants, such as quackgrass, fleabane daisy, knapweed, thistle, and other annual forbs and shrubs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning.

Mechanical seeding generally is not practical because of the stones in the surface layer. The unit can be seeded aerially or with a hand seeder. The stones interfere with the installation of fences and watering facilities.

The main limitations in the areas used as homesites are the hazard of flooding and the large stones. Excavating is difficult because of the stones. These sites should be disturbed as little as possible. The main limitations on sites for septic tank absorption fields are a poor filtering capacity and the large stones. If the density of housing is moderate or high, community sewage systems are needed to prevent the contamination of water supplies caused by seepage. Cutbanks are not stable and are subject to slumping. Landscaping and maintaining lawns are difficult because of exposed stones. Leveling can remove the stones, but it also can expose the underlying material. Establishing lawns is difficult if the underlying material is exposed. Mulching and applying fertilizer in cut areas help to establish plants.

This unit is in capability subclass VIIs, nonirrigated.

7-Bridgewater-Veazie Variant complex, 0 to 3 percent slopes. This map unit is on flood plains. It is occasionally flooded during the period January through May. The native vegetation is mainly trees, shrubs, and grasses. Elevation is 800 to 2,500 feet. The average annual precipitation is 12 to 19 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 120 to 150 days.

This unit is about 50 percent Bridgewater stony loam and 30 percent Veazie Variant extremely stony sandy loam. The Bridgewater soil is on flood plains, and the Veazie Variant is on flood plains adjacent to creeks. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas that are subject to rare or frequent flooding and areas of Joseph extremely stony loamy sand and Joseph extremely cobbly loamy sand. Also included are soils that have a surface layer of silt loam or loam and Bridgewater soils that have slopes of more than 3 percent. The included areas make up about 20 percent of the unit.

The Bridgewater soil is very deep and well drained. It formed in alluvium. Typically, the upper 8 inches of the surface layer is dark grayish brown stony loam. The lower 27 inches is dark grayish brown extremely cobbly sandy loam. The underlying material to a depth of 60 inches or more is brown extremely cobbly coarse sand. In some areas the surface layer is extremely stony, very stony, or stony sand or stony sandy loam.

Permeability is moderately rapid in the surface layer of the Bridgewater soil and very rapid in the underlying material. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

The Veazie Variant is very deep and moderately well drained. It formed in alluvium. Typically, the upper 6 inches of the surface layer is dark grayish brown extremely stony sandy loam. The lower 27 inches is dark grayish brown extremely cobbly sandy loam. The underlying material to a depth of 60 inches or more is grayish brown, mottled extremely cobbly coarse sand. In some areas the surface layer is very stony or stony sandy loam.

Permeability is moderately rapid in the surface layer of the Veazie Variant and very rapid in the underlying material. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The seasonal high water table is at a depth of 36 to 60 inches from January through May.

This unit is used as grazeable woodland or wildlife habitat. The production of vegetation is limited by the low available water capacity. The forest understory vegetation is hawthorn, creambush oceanspray, and wildrye on the Bridgewater soil and hawthorn, common snowberry, and wildrye on the Veazie Variant. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as sand dropseed and bluebunch wheatgrass, decreases and the proportion of the less preferred forage plants, such as lupine, yarrow, and shrubs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning.

Mechanical seeding generally is not practical because of the stoniness and the low available water capacity. The unit can be seeded aerially or with a hand seeder. The stones and the flooding interfere with the installation of fences and watering facilities.

Black cottonwood and ponderosa pine are the principal tree species on the Bridgewater soil. Thinleaf alder and water birch are of limited extent. On the basis of a 50-year site curve, the estimated mean site index is 65 for black cottonwood and 90 for ponderosa pine. The highest average growth rate in unmanaged, even-aged stands is an estimated 35 cubic feet per acre per year for black cottonwood at age 60. Yield information for ponderosa pine is not available.

Black cottonwood is the principal tree species on the Veazie Variant. Thinleaf alder is of limited extent. On the basis of a 50-year site curve, the mean site index is 80 for black cottonwood. The highest average growth rate in unmanaged, even-aged stands is 35 cubic feet per acre per year for black cottonwood at age 60.

The main limitation in the areas used for timber is the stoniness. The stones hinder harvesting activities. When felled, the timber can break on the stones. During an average year, snowpack limits the use of equipment and restricts access from December through March. Rock for road construction is readily available on this unit. A moderate degree of compaction can occur if equipment is used or logs are on the surface when the soils are moist. A moderate reduction in soil productivity can result from unmanaged fires in undisturbed areas.

Droughtiness in the surface layer reduces the seedling survival rate. Reforestation can be accomplished by planting ponderosa pine seedlings on the Bridgewater soil and black cottonwood seedlings on the Veazie Variant. Planting the seedlings is difficult because of the stones. If seed trees are available, natural reforestation of black cottonwood occurs readily in cutover areas. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy.

The Bridgewater soil is in capability subclass IVw, nonirrigated. The Veazie Variant is in capability subclass VIIs, nonirrigated.

8-Bridgewater Variant stony loam, 0 to 8 percent slopes. This very deep, moderately well drained soil is on flood plains. It is occasionally flooded during the period January through May. It formed in alluvium. The native vegetation is mainly trees, shrubs, and grasses. Elevation is 1,500 to 3,000 feet. The average annual precipitation is 19 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the upper 8 inches of the surface layer is dark gray stony loam. The lower 30 inches is dark grayish brown and grayish brown extremely cobbly loam. The underlying material to a depth of 60 inches or more is grayish brown extremely cobbly loamy coarse sand. In some areas the surface layer is extremely stony sandy loam or very stony loam.

Permeability is moderate in the surface layer and very rapid in the underlying material. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The seasonal high water table is at a depth of 36 to 60 inches during the period January through May.

Included in this unit are areas that are subject to rare or frequent flooding and areas of well drained soils on alluvial fans. Also included are soils that have a surface layer of extremely stony loamy sand, silt loam, or loam and soils that have slopes of more than 8 percent. The included areas make up about 20 percent of the unit.

This unit is used as grazeable woodland or wildlife habitat. The production of vegetation is limited by the low available water capacity. The forest understory vegetation is common snowberry, heartleaf arnica, Dutchmans breeches, and creambush oceanspray. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as elk sedge, fescue, and blue wildrye, decreases and the proportion of the less preferred plants, such as quackgrass, Kentucky bluegrass, common snowberry, and introduced annual forbs and grasses, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning.

The main limitations in the areas used for range seeding are the stoniness of the surface layer and the low available water capacity. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. The stones in the surface layer and the flooding interfere with the installation of fences and watering facilities.

Douglas fir and grand fir are the principal tree species on this unit. Grand fir, ponderosa pine, black cottonwood, and water birch are of limited extent. Based on a 50-year site curve, the mean site index is 75 for Douglas fir and 80 for grand fir. The highest average growth rate in unmanaged, even-aged stands is 73 cubic feet per acre per year for Douglas fir at age

99 and 114 cubic feet per acre per year for grand fir at age 107. In a typical basal area, however, the composition of Douglas fir and grand fir is reduced by about 50 percent and growth rates are reduced accordingly.

The main limitation affecting timber harvesting is the stoniness. When felled, the timber can break on the stones. During an average year, snowpack limits the use of equipment and restricts access from December through March. A moderate degree of compaction can occur if equipment is used or logs are on the surface when the soils are moist. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazard of compaction. A moderate reduction in soil productivity can result from unmanaged fires in undisturbed areas.

Droughtiness in the surface layer reduces the seedling survival rate. Reforestation can be accomplished by planting Douglas fir seedlings. Planting the seedlings is difficult because of the stones. If seed trees are available, natural reforestation by Douglas fir occurs readily in cutover areas. Seedlings that are planted or naturally established in the less fertile subsoil grow poorly and lack vigor.

This unit is in capability subclass IVs, nonirrigated.

9-Catheen-Spofmore silt loams, 8 to 15 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

This unit is about 45 percent Catheen silt loam and 40 percent Spofmore silt loam. The Catheen soil is in areas between slick spots, and the Spofmore soil occurs as scattered circular, concave slick spots 4 to 6 feet across. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Pataha silt loam, Peola silt loam, Neissenberg silt loam, Stember silt loam, and Catheen soils that have slopes of less than 8 percent or more than 15 percent. Also included are some areas where the depth to basalt is 40 to 60 inches. The included areas make up about 15 percent of the unit.

The Catheen soil is very deep and well drained. It formed in loess. Typically, the surface layer is dark grayish brown silt loam about 13 inches thick. The upper 12 inches of the subsoil is brown silty clay loam. The lower part to a depth of 60 inches or more is pale brown and brown silty clay loam. The soil is calcareous below a depth of about 25 inches.

Permeability is moderate in the Catheen soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

The Spofmore soil is very deep and moderately well drained. It formed in loess. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 11 inches of the subsoil is brown silty clay that has a high content of sodium. The next 6 inches is brown silty clay loam. The lower part to a depth of 60 inches or more is light gray and brown silt loam. The soil is calcareous below a depth of about 18 inches.

Permeability is slow in the Spofmore soil. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion and a high content of sodium in the subsoil of the Spofmore soil. A 3-year rotation of winter wheat, spring barley, and fallow is suitable. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred. Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Stripcropping can help to control water erosion on long slopes.

The Catheen soil is in capability subclass file, nonirrigated. The Spofmore soil is in capability subclass IVe, nonirrigated.

10-Catheen-Spofmore silt loams, 15 to 30 percent slopes. This map unit is on hillslopes. The native vegetation is mainly grasses. Elevation is 2,600 to

3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

This unit is about 55 percent Catheen silt loam and 30 percent Spofmore silt loam. The Catheen soil is in areas between slick spots, and the Spofmore soil occurs as circular, concave slick spots 4 to 6 feet across. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Pataha silt loam, Peola silt loam, Neissenberg silt loam, Stember silt loam, and Catheen soils that have slopes of less than 15 percent or more than 30 percent. Also included are areas where the depth to basalt is 40 to 60 inches. The included areas make up about 15 percent of the unit.

The Catheen soil is very deep and well drained. It formed in loess. Typically, the surface layer is dark grayish brown silt loam about 13 inches thick. The upper 12 inches of the subsoil is brown silty clay loam. The lower part to a depth of 60 inches or more is pale brown and brown silty clay loam. The soil is calcareous below a depth of about 25 inches.

Permeability is moderate in the Catheen soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

The Spofmore soil is very deep and moderately well drained. It formed in loess. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 11 inches of the subsoil is brown silty clay that has a high content of sodium. The next 6 inches is brown silty clay loam. The lower part to a depth of 60 inches or more is light gray and brown silt loam. The soil is calcareous below a depth of about 18 inches.

Permeability is slow in the Spofmore soil. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as nonirrigated cropland, hayland, or pasture. The main limitations in the areas used for nonirrigated crops are the hazard of water erosion and a high content of sodium in the subsoil of the Spofmore soil. A suitable cropping system includes a 3-year rotation of winter wheat, spring barley, and fallow about 50 percent of the time and grasses or grasses and legumes the other 50 percent. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred. Dividing the field slopes into two or more cropping patterns helps to control water erosion.

The main limitation in the areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seedling establishment.

This unit is in capability subclass IVe, nonirrigated.

11-Chard loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in loess and glaciofluvial deposits. The native vegetation is mainly grasses. Elevation is 800 to 1,300 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

Typically, the upper 8 inches of the surface layer is dark grayish brown loam. The lower 10 inches is brown loam. The upper 18 inches of the subsoil is brown fine sandy loam. The lower part to a depth of 60 inches or more is light brownish gray and grayish brown sandy loam. The soil is calcareous below a depth of about 31 inches. In some areas the surface layer is silt loam or sandy loam.

Permeability is moderate. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit are areas of Chard soils that have slopes of more than 5 percent. The included areas make up about 10 percent of the unit.

This unit is used for nonirrigated or irrigated crops or for homesite development. The main limitation in the areas used as nonirrigated cropland is the low annual precipitation. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, spring grain, and fallow is needed. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Stripcropping can help to control water erosion on long slopes.

The main limitation in the areas used for irrigated crops is the hazard of water erosion. The main irrigated crops are grapes, orchard crops, alfalfa, corn, potatoes, beans, and peas. Furrow, corrugation, trickle, and sprinkler irrigation systems are suitable. Furrow and corrugation irrigation systems are suitable in areas of close-grown crops. Excessive water application rates can result in crusting, which impairs aeration and reduces the rate of water intake. Minimizing tillage and returning crop residue to the soil help to maintain or increase the organic matter content, help to maintain tilth, and increase the rate of water infiltration. Including close-growing, high-residue crops in the rotation and keeping crop residue on the surface help to control water erosion. Growing cover crops helps to control erosion in orchards and vineyards. Land smoothing operations should include only shallow cuts that do not expose the substratum.

This unit has few limitations in the areas used as homesites. If the density of housing is moderate or high, community sewage systems are needed to prevent the contamination of water supplies caused by seepage. Cutbanks are not stable and are subject to slumping. Establishing lawns is difficult if the surface layer has been removed and the subsoil is exposed. Mulching and applying fertilizer in cut areas help to establish plants.

This unit is in capability subclasses IIe, irrigated, and IIIe, nonirrigated.

12-Chard loam, 5 to 10 percent slopes. This very deep, well drained soil is on terraces. It formed in loess and glaciofluvial deposits. The native vegetation is mainly grasses. Elevation is 800 to 1,300 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

Typically, the upper 8 inches of the surface layer is dark grayish brown loam. The lower 10 inches is brown loam. The upper 18 inches of the subsoil is brown fine sandy loam. The lower part to a depth of 60 inches or more is light brownish gray and grayish brown sandy loam. The soil is calcareous below a depth of about 31 inches. In some areas the surface layer is silt loam or sandy loam.

Permeability is moderate. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Chard soils that have slopes of less than 5 percent or more than 10 percent. The included areas make up about 10 percent of the unit.

This unit is used for nonirrigated or irrigated crops or for homesite development. The main limitations in the areas used for nonirrigated crops are the hazard of water erosion and the low annual precipitation. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, spring barley, and fallow is needed. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Stripcropping can help to control water erosion on long slopes.

The main limitation affecting irrigated crops is the hazard of water erosion. The main irrigated crops are grapes, orchard crops, and alfalfa. Sprinkler and trickle irrigation systems are suitable. Excessive water application rates can result in crusting, which impairs aeration and reduces the rate of water intake. Minimizing tillage and returning crop residue to the soil help to maintain or increase the organic matter content, help to maintain tilth, and increase the rate of water infiltration. Including close-growing, high-residue crops in the rotation and keeping crop residue on the surface help to control water erosion. Growing cover crops helps to control erosion in orchards and vineyards. Land smoothing operations should include only shallow cuts that do not expose the substratum.

This unit has few limitations in the areas used as homesites. If the density of housing is moderate or high, community sewage systems are needed to prevent the contamination of water supplies caused by seepage. Cutbanks are not stable and are subject to slumping. Establishing lawns is difficult if the surface layer has been removed and the subsoil is exposed.

Mulching and applying fertilizer in cut areas help to establish plants.

This unit is in capability subclass IIIe, irrigated and nonirrigated.

13-Chard loam, 10 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in loess and glaciofluvial deposits. The native vegetation is mainly grasses. Elevation is 800 to 1,300 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

Typically, the upper 8 inches of the surface layer is dark grayish brown loam. The lower 10 inches is brown loam. The upper 18 inches of the subsoil is brown fine sandy loam. The lower part to a depth of 60 inches or more is light brownish gray and grayish brown sandy loam. The soil is calcareous below a depth of about 31 inches. In some areas the surface layer is silt loam or sandy loam.

Permeability is moderate. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Chard soils that have slopes of less than 10 percent or more than 15 percent. The included areas make up about 10 percent of the unit.

This unit is used for nonirrigated and irrigated crops, hay or pasture, or homesite development. The main limitations in the areas used for nonirrigated crops are the hazard of water erosion and the low annual precipitation. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, spring barley, and fallow is needed. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Stripcropping can help to control water erosion on long slopes.

The main limitation affecting irrigated cropland is the hazard of water erosion. This unit is suited to high-residue, close-growing crops, such as alfalfa, and to orchards and vineyards. Sprinkler and trickle irrigation systems are suitable. Excessive water application rates can result in crusting, which impairs aeration and reduces the rate of water intake. Minimizing tillage and returning crop residue to the soil help to maintain or increase the organic matter content, help to maintain tilth, and increase the rate of water infiltration. Including close-growing, high-residue crops in the rotation and keeping crop residue on the surface help to control water erosion. Growing cover crops helps to control erosion in orchards and vineyards. Land smoothing operations should include only shallow cuts that do not expose the substratum.

This unit has few limitations in the areas used for hay or pasture. The use of equipment is limited by the slope.

The main limitation in the areas used as homesites is the slope. Buildings require special design to overcome this limitation. The slope also is the main limitation on sites for septic tank absorption fields. It hinders installation of the absorption fields. The absorption lines should be installed on the contour. If the density of housing is moderate or high, community sewage systems are needed to prevent the contamination of water supplies caused by seepage. Cutbanks are not stable and are subject to slumping. Establishing lawns is difficult if the surface layer has been removed and the subsoil is exposed. Mulching and applying fertilizer in cut areas help to establish plants.

This unit is in capability subclass IVe, irrigated, and IIIe, nonirrigated.

14-Chard loam, 15 to 25 percent slopes. This very deep, well drained soil is on terraces. It formed in loess and glaciofluvial deposits. The native vegetation is mainly grasses. Elevation is 800 to 1,300 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

Typically, the upper 8 inches of the surface layer is dark grayish brown loam. The lower 10 inches is brown loam. The upper 18 inches of the subsoil is brown fine sandy loam. The lower part to a depth of 60 inches or more is light brownish gray and grayish brown sandy loam. The soil is calcareous below a depth of about 31 inches. In some areas the surface layer is silt loam or sandy loam.

Permeability is moderate. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Dallesport very gravelly sandy loam and Chard soils that have slopes of less than 15 percent or more than 25 percent. Also included are convex areas of Chard soils that have a surface layer of sandy loam, have coarse sand within a depth of 60 inches, and have secondary lime within a depth of 20 inches. The included areas make up about 15 percent of the unit.

This unit is used for nonirrigated or irrigated crops, hay or pasture, or homesite development. The main limitations in the areas used for nonirrigated crops are the hazard of water erosion and the low annual precipitation. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or a 3-year rotation of winter wheat, spring grain, and fallow less than 50 percent of the time is needed. Growing grasses or grasses and legumes in the rotation about 50 percent of the time helps to control water erosion and maintain tilth. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Dividing the field slopes into two or more cropping patterns helps to control water erosion.

The main limitation affecting irrigated cropland is the hazard of water erosion. If irrigated, this unit is suited to high-residue, close-growing crops, such as alfalfa, and to orchard crops and vineyards. Sprinkler and trickle irrigation systems are suitable. If sprinklers are used, excessive water application rates can result in crusting, which impairs aeration and reduces the rate of water intake. Minimizing tillage and returning crop residue to the soil help to maintain or increase the organic matter content, help to maintain tilth, and increase the rate of water infiltration. Including close-growing, high-residue crops in the rotation and keeping crop residue on the surface help to control water erosion. Growing cover crops helps to control erosion in orchards and vineyards. Land smoothing operations should include only shallow cuts that do not expose the substratum.

The main limitation in the areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on or nearly on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seedling establishment.

The main limitation in the areas used as homesites is the slope. Buildings require special design to overcome this limitation. The slope also is the main limitation on sites for septic tank absorption fields. Cutbanks are not stable and are subject to slumping. Establishing lawns is difficult if the surface layer has been removed and the subsoil is exposed. Mulching and applying fertilizer in cut areas help to establish plants.

This unit is in capability subclass IVe, irrigated and nonirrigated.

15-Chard loam, 25 to 40 percent slopes. This very deep, well drained soil is on terrace escarpments. It formed in loess and glaciofluvial deposits. The native vegetation is mainly grasses. Elevation is 800 to 1,300 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

Typically, the upper 8 inches of the surface layer is dark grayish brown loam. The lower 10 inches is brown loam. The upper 18 inches of the subsoil is brown fine sandy loam. The lower part to a depth of 60 inches or more is light brownish gray and grayish brown sandy loam. The soil is calcareous below a depth of about 31 inches. In some areas the surface layer is silt loam, loam, or sandy loam.

Permeability is moderate. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

Included in this unit are areas of Dallesport very gravelly sandy loam and Chard soils that have slopes of less than 25 percent or more than 40 percent. Also included are convex areas of Chard soils that have coarse sand within a depth of 60 inches and secondary lime within a depth of 20 inches. The included areas make up about 15 percent of the unit.

This unit is used for hay or pasture, nonirrigated crops, or homesite development. The main limitation in the areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seedling establishment.

The main limitations affecting nonirrigated cropland are the hazard of water erosion and the low annual precipitation. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or a 3-year rotation of winter wheat, spring grain, and fallow less than 50 percent of the time is needed. Growing grasses or grasses and legumes in the rotation about 75 percent of the time helps to control water erosion and maintain tilth.

On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Dividing the field slopes into two or more cropping patterns helps to control water erosion on part of the slopes.

The main limitation in the areas used as homesites is the slope. Buildings require special design to overcome this limitation. The slope also is the main limitation on sites for septic tank absorption fields. Cutbanks are not stable and are subject to slumping. Establishing lawns is difficult if the surface layer has been removed and the subsoil is exposed. Mulching and applying fertilizer in cut areas help to establish plants.

This unit is in capability subclass VIe, irrigated and nonirrigated.

16-Chard loam, 40 to 60 percent slopes. This very deep, well drained soil is on terrace escarpments. It formed in loess and glaciofluvial deposits. The native vegetation is mainly grasses. Elevation is 800 to 1,300 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

Typically, the upper 8 inches of the surface layer is dark grayish brown loam. The lower 10 inches is brown loam. The upper 18 inches of the subsoil is brown fine sandy loam. The lower part to a depth of 60 inches or more is light brownish gray and grayish brown sandy loam. The soil is calcareous below a depth of about 31 inches. In some areas the surface layer is silt loam or sandy loam.

Permeability is moderate. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very severe.

Included in this unit are areas of Dallesport very gravelly sandy loam, Dallesport very cobbly sandy loam, and Chard soils that have slopes of less than 40 percent or more than 60 percent. The included areas make up about 15 percent of the unit.

This unit has few limitations in areas used as rangeland or wildlife habitat. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and needlegrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue and bluebunch wheatgrass, decreases and the proportion of the less preferred plants, such as downy brome, Japanese brome, and mustard, increases.

The steep north-facing slopes are hazardous to livestock when the soil is frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soil remains saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or controlled burning. Properly locating salt licks, watering facilities, and fences can improve the distribution of livestock grazing. The main limitations affecting range seeding are the slope and the hazard of water erosion.

Mechanical seeding generally is not practical because of the slope. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder.

This unit is in capability subclass VIIe, nonirrigated.

17-Cloverland silt loam, 3 to 8 percent slopes. This deep, moderately well drained soil is on mountain plateaus and benches. It formed in loess that has a minor amount of slope alluvium derived from weathered basalt and volcanic ash. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,400 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface is covered with a mat of partly decomposed needles and twigs about 2 inches thick. The upper 6 inches of the surface layer is dark grayish brown silt loam. The lower 4 inches is grayish brown silt loam. The subsoil is about 27 inches of brown and light brownish gray silt loam. Below this is a buried subsoil. The upper 13 inches of the buried subsoil is brown silty clay loam. The lower 6 inches is brown very cobbly clay loam, which is underlain by basalt at a depth of about 56 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderate in the upper part of the profile and slow in the buried subsoil. Available water capacity is very high. The effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate. The seasonal high water table is at a depth of 18 to 36 inches during the period February through May.

Included in this unit are areas of Sweiting silt loam, Tolo silt loam, and Cloverland soils that have slopes of more than 8 percent. Also included are some areas where the depth to basalt is more than 60 inches and some convex areas of Cloverland soils that have a buried subsoil at a depth of 20 to 25 inches. The included areas make up about 25 percent of the unit.

This unit is used mainly as grazeable woodland, hayland, pasture, nonirrigated cropland, or wildlife habitat. Ponderosa pine and Douglas fir are the principal tree species. Western larch is of limited extent.

The habitat type is dominantly Douglas fir-ninebark and partly Douglas fir-snowberry. On the basis of a 100-year site curve, the mean site index is 80 for ponderosa pine. On the basis of a 50-year site curve, it is estimated to be 70 for Douglas fir. The highest average growth rate in unmanaged, even-aged stands is 71 cubic feet per acre per year for ponderosa pine at age 40 and is estimated to be 61 cubic feet per acre per year for Douglas fir at age 103. In a typical basal area, however, the composition of ponderosa pine is reduced by about 65 percent and the composition of Douglas fir is reduced by about 50 percent. Growth rates are reduced accordingly.

The main limitations affecting timber harvesting are occasional snowpack and the muddiness caused by seasonal wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced roads are soft and slippery when wet and can be impassable during rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Equipment and logs on the surface when the soil is wet or moist can result in a high degree of compaction and puddling. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction and puddling.

Seedling establishment is the main concern affecting the production of timber. Reforestation can be accomplished by planting ponderosa pine or Douglas fir seedlings. If seed trees are available, natural reforestation of ponderosa pine and Douglas fir occurs readily in cutover areas and reforestation of western larch occurs periodically. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means.

The forest understory vegetation is mallow ninebark, pinegrass, common snowberry, and Saskatoon serviceberry. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as mallow ninebark, pinegrass, and common snowberry, decreases and the proportion of the less preferred forage plants, such as annual bromes, lupine, and annual forbs, increases. The density of the overstory generally is the main factor that limits the kind and amount of forage. Areas that have an excessive number of undesirable shrubs can be improved by chemical or mechanical treatment or prescribed burning.

This soil is suited to seeding. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. Undesirable plants can be controlled by chemical treatment.

This unit has few limitations in the areas used for hay or pasture. The main limitations in the areas used for nonirrigated crops are the hazard of water erosion, the short growing season, and wetness in the spring. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The main crops are wheat, barley, and oats. Spring barley and oats are better suited to the weather conditions in this unit and to late spring planting than is spring wheat.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Field diversions can intercept excess runoff from the steeper soils upslope and minimize gullying.

This unit is in capability subclass IIIe, nonirrigated.

18-Cloverland silt loam, 8 to 30 percent slopes. This deep, moderately well drained soil is on mountain plateaus and benches. It formed in loess that has a minor amount of slope alluvium derived from weathered basalt and volcanic ash. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,400 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface is covered with a mat of partly decomposed needles and twigs about 2 inches thick. The upper 6 inches of the surface layer is dark grayish brown silt loam. The lower 4 inches is grayish brown silt loam. The subsoil is about 27 inches of brown and light brownish gray silt loam. Below this is a buried subsoil. The upper 13 inches of the buried subsoil is brown silty clay loam. The lower 6 inches is brown very cobbly clay loam, which is underlain by basalt at a depth of about 56 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderate in the upper part of the profile and slow in the buried subsoil. Available water capacity is very high. The effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate. The seasonal high water table is at a depth of 18 to 36 inches during the period February through May.

Included in this unit are areas of Sweiting silt loam, Tolo silt loam, and Cloverland soils that have slopes of less than 8 percent or more than 30 percent. Also included are some areas where the depth to basalt is more than 60 inches and some convex areas of Cloverland soils that have a buried subsoil at a depth of 20 to 25 inches. The included areas make up about 25 percent of the unit.

This unit is used as grazeable woodland, hayland, pasture, nonirrigated cropland, or wildlife habitat. Ponderosa pine and Douglas fir are the principal tree species. Western larch is of limited extent. The habitat type is dominantly Douglas fir-ninebark and partly Douglas fir-snowberry. On the basis of a 100-year site curve, the mean site index is 80 for ponderosa pine. On the basis of a 50-year site curve, it is estimated to be 70 for Douglas fir. The highest average growth rate in unmanaged, even-aged stands is 71 cubic feet per acre per year for ponderosa pine at age 40 and is estimated to be 61 cubic feet per acre per year for Douglas fir at age 103. In a typical basal area, however, the composition of ponderosa pine is reduced by about 65 percent and the composition of Douglas fir is reduced by about 50 percent. Growth rates are reduced accordingly.

The main limitations affecting timber harvesting are occasional snowpack and the muddiness caused by seasonal wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced roads are soft and slippery when wet and can be impassable during rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Equipment and logs on the surface when the soil is wet or moist can result in a high degree of compaction and puddling. Steep skid trails and firebreaks are subject to rilling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, and erosion.

Seedling establishment is the main concern affecting the production of timber. Reforestation can be accomplished by planting ponderosa pine or Douglas fir seedlings. If seed trees are available, natural reforestation of ponderosa pine and Douglas fir occurs readily in cutover areas and reforestation of western larch occurs periodically. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means.

The forest understory vegetation is mallow ninebark, mountain brome, pinegrass, common snowberry, and Saskatoon serviceberry. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as mallow ninebark, pinegrass, common snowberry, and rose, decreases and the proportion of the less preferred forage plants, such as annual bromes, thistle, and annual forbs, increases. The density of the overstory generally is the main factor that limits the kind and amount of forage. Areas that have an excessive number of undesirable shrubs can be improved by chemical or mechanical treatment.

This soil is suited to seeding. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. Undesirable plants can be controlled by chemical treatment prior to seeding.

The main limitation in areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on the contour or across the slope can help to control rill erosion. Leaving crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seedling establishment.

The main limitations affecting nonirrigated cropland are the hazard of water erosion, the short growing season, and wetness in the spring. The principal crops are wheat, barley, and oats. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. Spring barley and oats are better suited to the weather conditions in this unit and to late spring planting than is spring wheat.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Dividing the field slopes into two or more cropping patterns helps control water erosion on part of the slopes.

This unit is in capability subclass IVe, nonirrigated.

19-Cloverland silt loam, very deep, 3 to 8 percent slopes. This moderately well drained soil is on mountain plateaus and benches. It formed in loess that has a minor amount of slope alluvium derived from weathered basalt and volcanic ash. The vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,400 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface is covered with a mat of partly decomposed needles and twigs about 2 inches thick. The upper 6 inches of the surface layer is dark grayish brown silt loam. The lower 4 inches is grayish brown silt loam. The subsoil is about 27 inches of brown and light brownish gray silt loam. Below this to a depth of 60 inches or more is a buried subsoil of brown silty clay loam.

Permeability is moderate in the upper part of the profile and slow in the buried subsoil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The seasonal high water table is at a depth of 18 to 36 inches during the period February through May.

Included in this unit are areas of Sweiting silt loam, Tolo silt loam, and Cloverland soils that have slopes of more than 8 percent. Also included are some areas where the depth to basalt is 40 to 60 inches. The included areas make up about 25 percent of the unit.

This unit is used as grazeable woodland, hayland, pasture, nonirrigated cropland, or wildlife habitat. Ponderosa pine and Douglas fir are the principal tree species. Western larch is of limited extent. The habitat type is dominantly Douglas fir-ninebark and partly Douglas fir-snowberry. On the basis of a 100-year site curve, the mean site index is 100 for ponderosa pine. On the basis of a 50-year site curve, it is 80 for Douglas fir. The highest average growth rate in unmanaged, even-aged stands is 102 cubic feet per acre per year for ponderosa pine at age 40 and 81 cubic feet per acre per year for Douglas fir at age 97. In a typical basal area, however, the composition of ponderosa pine and Douglas fir is reduced by about 60 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting are occasional snowpack and the muddiness caused by seasonal wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced roads are soft and slippery when wet and can be impassable during rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Equipment and logs on the surface when the soil is wet or moist can result in a high degree of compaction and puddling. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction and puddling.

Seedling establishment is the main concern affecting the production of timber. Reforestation can be accomplished by planting ponderosa pine or Douglas fir seedlings. If seed trees are available, natural reforestation of ponderosa pine and Douglas fir occurs readily in cutover areas. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means.

The forest understory vegetation is mallow ninebark, pinegrass, common snowberry, spire, and rose. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as mallow ninebark, pinegrass, common snowberry, spire, and rose, decreases and the proportion of the less preferred forage plants, such as annual bromes, snowberry, and annual forbs, increases. Generally, the density of the overstory is the main factor that limits the kind and amount of forage. Areas that have an excessive number of undesirable shrubs can be improved by chemical or mechanical treatment.

This soil is suited to seeding. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. Undesirable plants can be controlled by chemical treatment prior to seeding.

This unit has few limitations in the areas used for hay or pasture. The main limitations affecting nonirrigated cropland are the hazard of water erosion, the short growing season, and wetness in the spring. A suitable rotation is annual grain. The principal crops are wheat, barley, and oats. Spring barley and oats are better suited to the weather conditions in this unit and to late spring planting than is spring wheat. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Field diversions intercept excess runoff from upslope areas and minimize gullying.

This unit is in capability subclass IIIe, nonirrigated.

20-Cloverland silt loam, *very* deep, 8 to 30 percent slopes. This moderately well drained soil is on mountain plateaus and benches. It formed in loess that has a minor amount of slope alluvium derived from weathered basalt and volcanic ash. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,400 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface is covered with a mat of partly decomposed needles and twigs about 2 inches thick. The upper 6 inches of the surface layer is dark grayish brown silt loam. The lower 4 inches is grayish brown silt loam. The subsoil is about 27 inches of brown and light brownish gray silt loam. Below this to a depth of 60 inches or more is a buried subsoil of brown silty clay loam.

Permeability is moderate in the upper part of the profile and slow in the buried subsoil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe. The seasonal high water table is at a depth of 18 to 36 inches during the period February through May.

Included in this unit are areas of Sweiting silt loam, Tolo silt loam, and Cloverland soils that have slopes of less than 8 percent or more than 30 percent. Also included are some areas where the depth to basalt is 40 to 60 inches and some areas of Cloverland soils that have a buried subsoil at a depth of 20 to 25 inches. The included areas make up about 25 percent of the unit.

This unit is used as grazeable woodland, hayland, pasture, nonirrigated cropland, or wildlife habitat. Ponderosa pine and Douglas fir are the principal tree species. Western larch is of limited extent. The habitat type is dominantly Douglas fir-ninebark and partly Douglas fir-snowberry. On the basis of a 100-year site curve, the mean site index is 100 for ponderosa pine. On the basis of a 50-year site curve, it is 80 for Douglas fir. The highest average growth rate in unmanaged, even-aged stands is 102 cubic feet per acre per year for ponderosa pine at age 40 and 81 cubic feet per acre per year for Douglas fir at age 97. In a typical basal area, however, the composition of ponderosa pine and Douglas fir is reduced by about 60 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting are occasional snowpack and the muddiness caused by seasonal wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced roads are soft and slippery when wet and can be impassable during rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Equipment and logs on the surface when the soil is wet or moist can result in a high degree of compaction and puddling. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, and erosion.

Seedling establishment is the main concern affecting the production of timber. Reforestation can be accomplished by planting ponderosa pine or Douglas fir seedlings. If seed trees are available, natural reforestation of ponderosa pine and Douglas fir occurs readily in cutover areas. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means.

The forest understory vegetation is mallow ninebark, pinegrass, common snowberry, spirea, and rose. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as mallow ninebark, pinegrass, common snowberry, and cream bush ocean spray, decreases and the proportion of the less preferred plants, such as annual bromes, snowberry, and annual forbs, increases. Generally, the density of the overstory is the main factor that limits the kind and amount of forage. Areas that have an excessive number of undesirable shrubs can be improved by chemical or mechanical treatment.

This unit is suited to seeding. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. Undesirable plants can be controlled by chemical treatment prior to seeding.

The main limitation in areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on or nearly on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seedling establishment.

The main limitations affecting nonirrigated cropland are the hazard of water erosion, the short growing season, and wetness in the spring. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The main crops are wheat, barley, and oats. The weather conditions may result in a late spring planting date. Spring barley and oats are better suited to the weather conditions in this unit and to late spring planting than is spring wheat.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Dividing the field slopes into two or more cropping patterns helps to control water erosion on part of the slopes.

This unit is in capability subclass IIIe, nonirrigated.

21-Cloverland silt loam, very deep, 30 to 45 percent slopes. This moderately well drained soil is on north-facing hillslopes. It formed in loess that has a minor amount of slope alluvium derived from weathered basalt and volcanic ash. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,400 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface is covered with a mat of partly decomposed needles and twigs about 2 inches thick. The upper 6 inches of the surface layer is dark grayish brown silt loam. The lower 4 inches is grayish brown silt loam. The subsoil is about 27 inches of brown and light brownish gray silt loam. Below this to a depth of 60 inches or more is a buried subsoil of brown silty clay loam. In some areas the depth to basalt is 40 to 60 inches.

Permeability is moderate in the upper part of the profile and slow in the buried subsoil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very severe. The seasonal high water table is at a depth of 18 to 36 inches during the period February through May.

Included in this unit are areas of Sweiting silt loam, Tolo silt loam, and Cloverland soils that have slopes of less than 30 percent or more than 45 percent. The included areas make up about 25 percent of the unit.

This unit is used as grazeable woodland or wildlife habitat. Ponderosa pine and Douglas fir are the principal tree species. Western larch is of limited extent. The habitat type is dominantly Douglas fir-ninebark and partly Douglas fir-snowberry. On the basis of a 100-year site curve, the mean site index is 100 for ponderosa pine. On the basis of a 50-year site curve, it is estimated to be 80 for Douglas fir. The highest average growth rate in unmanaged, even-aged stands is 71 cubic feet per acre per year for ponderosa pine at age 40 and is estimated to be 61 cubic feet per acre per year for Douglas fir at age 103. In a typical basal area, however, the composition of ponderosa pine is reduced by about 65 percent and the composition of Douglas fir is reduced by about 50 percent. Growth rates are reduced accordingly.

The main limitations affecting timber harvesting are the slope, occasional snowpack, and the muddiness caused by seasonal wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced roads are soft and slippery when wet and can be impassable during rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Equipment and logs on the surface when the soil is wet or moist can result in a high degree of compaction and puddling. Steep skid trails and firebreaks are subject to rilling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, and erosion.

Seedling establishment is the main concern affecting the production of timber. Reforestation can be accomplished by planting ponderosa pine or Douglas fir seedlings. If seed trees are available, natural reforestation of ponderosa pine and Douglas fir occurs readily in cutover areas and reforestation of western larch occurs periodically. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means.

The forest understory vegetation is mallow ninebark, pinegrass, common snowberry, spirea, and rose. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as mallow ninebark, pinegrass, common snowberry, spirea, and rose, decreases and the proportion of the less preferred plants, such as annual bromes, yarrow, thistle, snowberry, and annual (orbs, increases. Generally, the density of the overstory is the main factor that limits the kind and amount of forage.

This unit is suited to seeding. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. Undesirable plants can be controlled by chemical treatment.

This unit is in capability subclass VIe, nonirrigated.

22-Crackercreek stony silt loam, 30 to 60 percent slopes. This deep, well drained soil is on north-facing mountain slopes and canyon walls. It formed in a mantle of volcanic ash over colluvium derived from loess and material weathered from basalt. The native vegetation is mainly conifers. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface is covered with a mat of partially decomposed needles and twigs about 1 inch thick. The surface layer is brown stony silt loam about 2 inches thick. The subsoil is about 13 inches of yellowish brown stony silt loam. Below this is a buried subsoil. The upper 11 inches of the buried subsoil is yellowish brown very gravelly loam. The lower 25 inches is extremely cobbly loam, which is underlain by basalt at a depth of about 51 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

Included in this unit are areas of Tolo silt loam, Getaway stony silt loam, and Crackercreek soils that have basalt at a depth of less than 40 inches or more than 60 inches. Also included are small areas of soils that are similar to the Crackercreek soil but have a cooler temperature and are at elevations above 4,800 feet and small areas of Crackercreek soils that have slopes of less than 30 percent or more than 60 percent. The included areas make up about 25 percent of the unit.

This unit is used as grazeable woodland or wildlife habitat. Grand fir and Douglas fir are the principal tree species. Western larch, ponderosa pine, and lodgepole pine are of limited extent. The habitat type is generally grand fir-pachistima. On the basis of a 50-year site curve, the mean site index is estimated to be 70 for grand fir and is 68 for Douglas fir. The highest average growth rate in unmanaged, even-aged stands is about 104 cubic feet per acre per year for grand fir at age 110 and 54 cubic feet per acre per year for Douglas fir at age 106. In a typical basal area, however, the composition of grand fir is reduced by about 75 percent and the composition of Douglas fir is reduced by about 85 percent. Growth rates are reduced accordingly.

The main limitations affecting timber harvesting are the slope and occasional snowpack. During an average year, snowpack limits the use of equipment and restricts access from December through March. The slope restricts the use of wheeled and tracked skidding equipment. Generally, cable yarding systems are safer and result in less surface disturbance. Unsurfaced logging roads are slippery and soft when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit. Cut and fill slopes are somewhat erodible. Establishing a plant cover in these disturbed areas reduces the hazard of erosion. On unsurfaced logging roads, measures that abate dustiness during dry periods are needed to reduce road surface degradation and improve visibility.

Equipment and logs on the surface can result in a high degree of compaction and puddling when the soil is wet or moist and displacement when the soil is dry. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out cable yarding paths, properly timing their use, or using cable systems that lift logs entirely off the ground can reduce the hazards of displacement and erosion. A moderate reduction in soil productivity can result from unmanaged fires in undisturbed areas.

Seedling establishment is the main concern affecting the production of timber. Reforestation can be accomplished by planting Douglas fir or western larch seedlings. If seed trees are available, natural reforestation of Douglas fir and grand fir occurs readily in cutover areas. If not controlled, invading brushy plants cart delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means.

The forest understory vegetation is pinegrass, common snowberry, longtube twinflower, and spirea. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as common snowberry, longtube twinflower, spirea, and huckleberry, decreases and the proportion of the less preferred plants, such as snowberry, ceanothus, and pinegrass, increases. Generally, the density of overstory is the main factor that limits the kind and amount of forage.

Mechanical seeding is generally not practical on this unit because of the slope and the stones in the surface layer. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder.

This unit is in capability subclass VIIe, nonirrigated.

23-Dallesport very gravelly sandy loam, 3 to 10 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in old alluvial sand and gravel having a minor amount of loess in the upper part. The native vegetation is mainly grasses. Elevation is 750 to 1,200 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

Typically, the surface layer is dark grayish brown very gravelly sandy loam about 5 inches thick. The subsoil is about 8 inches of brown very gravelly sandy loam. The upper 37 inches of the substratum is brown and light brownish gray very gravelly sand. The lower part to a depth of more than 60 inches is light brownish gray extremely gravelly sand. The soil is calcareous below a depth of about 50 inches.

Permeability is moderately rapid in the surface layer and subsoil and *very* rapid in the substratum. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit are areas of Chard loam, Dallesport very cobbly sandy loam, and Dallesport soils that have slopes of more than 10 percent. The included areas make up about 25 percent of the unit.

This unit is used as rangeland or wildlife habitat. The production of vegetation suitable for grazing by livestock is limited because of the low available water capacity.

The potential native vegetation is bluebunch wheatgrass, sand dropseed, and balsamroot. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and sand dropseed, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, yarrow, knapweed, and prickly lettuce, increases. Areas that have an excessive number of undesirable shrubs can be improved by mechanical treatment, chemical treatment, or prescribed burning.

This unit is suited to range seeding by a single- or double-disk drill, a deep-furrow drill, or a rangeland drill. Proper timing of seeding is critical if seedlings are to be established.

This unit is in capability subclass VIs, nonirrigated.

24-Dallesport very cobbly sandy loam, 30 to 60 percent slopes. This very deep, somewhat excessively drained soil is on terrace escarpments. It formed in old alluvial sand and gravel having a minor amount of eolian deposits in the upper part. The native vegetation is mainly grasses. Elevation is 750 to 1,200 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

Typically, the surface layer is dark grayish brown very cobbly sandy loam about 5 inches thick. The subsoil is about 8 inches of brown very gravelly sandy loam. The upper 37 inches of the substratum is brown and light brownish gray very gravelly sand. The lower part to a depth of more than 60 inches is light brownish gray extremely gravelly sand. The soil is calcareous below a depth of about 50 inches.

Permeability is moderately rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very severe.

Included in this unit are areas of Chard loam, Dallesport very gravelly sandy loam, and Dallesport soils that have slopes of less than 30 percent or more than 60 percent. The included areas make up about 25 percent of the unit.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low available water capacity. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, sand dropseed, and balsamroot. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and sand dropseed, decreases and the proportion of the less preferred forage plants, such as cheatgrass, brome snakeweed, yarrow, and prickly lettuce, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

This soil is suited to seeding by a deep-furrow drill or a rangeland drill. The proper seeding time is critical because of the droughtiness of the soil. The cobbles or stones on the surface can interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIe, nonirrigated.

25-DeMasters complex, 8 to 30 percent slopes. This map unit is on north-facing foot slopes. The native vegetation is mainly shrubs and grasses. Elevation is 3,000 to 4,500 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 90 to 110 days.

This unit is about 45 percent DeMasters silt loam and 30 percent DeMasters stony silt loam. DeMasters silt loam is in concave areas and on foot slopes, and DeMasters stony silt loam is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of DeMasters stony silt loam that has basalt within a depth of 40 inches and slopes of more than 30 percent. Also included are some areas where the depth to basalt is more than 60 inches. The included areas make up about 25 percent of the unit.

DeMasters silt loam is deep and well drained. It formed in colluvium derived from weathered basalt and in loess that has some volcanic ash. Typically, the upper 9 inches of the surface layer is black silt loam. The lower 15 inches is very dark grayish brown silt loam. The upper 9 inches of the subsoil is dark brown cobbly loam. The lower 11 inches is brown very cobbly loam, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderate in DeMasters silt loam. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

DeMasters stony silt loam is moderately deep and well drained. It formed in colluvium derived from weathered basalt and in loess that has some volcanic ash. Typically, the upper 6 inches of the surface layer is very dark grayish brown stony silt loam. The lower 18 inches is very dark grayish brown silt loam. The upper 9 inches of the subsoil is dark brown cobbly loam. The lower 9 inches is brown very cobbly loam, which is underlain by basalt at a depth of about 42 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderate in DeMasters stony silt loam. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the short growing season. The potential native vegetation is Idaho fescue, common snowberry, and bluebunch wheatgrass on DeMasters silt loam and bluebunch wheatgrass and Idaho fescue on DeMasters stony silt loam. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as annual bromes, lupine, yarrow, annual forbs, rose, and snowberry, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

This unit is suited to range seeding if a rangeland drill or other types of drills are used and the stony areas are avoided. The main limitation is the stoniness of DeMasters stony silt loam. The stones can interfere with the installation of fences and watering facilities. Undesirable plants can be controlled by chemical treatment.

DeMasters silt loam is in capability subclass IVe, nonirrigated. DeMasters stony silt loam is in capability subclass VIe, nonirrigated.

26-DeMasters-Snell complex, 30 to 70 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly shrubs and grasses. Elevation is 3,000 to 4,500 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 90 to 110 days.

This unit is about 45 percent DeMasters silt loam and 30 percent Snell stony loam. The DeMasters soil is in concave areas, in smooth areas, and on foot slopes, and the Snell soil is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Harlow very stony clay loam, Rock outcrop, Snell soils that have basalt at a depth of more than 40 inches, and DeMasters soils that have slopes of more than 70 percent. Also included are areas of Bridgewater extremely stony sandy loam on alluvial fans and flood plains. The included areas make up about 25 percent of the unit.

The DeMasters soil is deep and well drained. It formed in colluvium derived from weathered basalt and in loess that has some volcanic ash. Typically, the upper 9 inches of the surface layer is black silt loam. The lower 15 inches is very dark grayish brown silt loam. The upper 9 inches of the subsoil is dark brown cobbly loam. The lower 11 inches is brown very cobbly loam, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderate in the DeMasters soil. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Snell soil is moderately deep and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the upper 6 inches of the surface layer is *very* dark grayish brown stony loam. The lower 6 inches is dark grayish brown very gravelly clay loam. The subsoil is about 13 inches of dark grayish brown very cobbly clay loam and brown extremely cobbly clay loam, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is moderately slow in the Snell soil. Available water capacity is low. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low available water capacity in the Snell soil and the short growing season.

The potential native vegetation is Idaho fescue, common snowberry, and bluebunch wheatgrass on the DeMasters soil and Idaho fescue and bluebunch wheatgrass on the Snell soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as annual bromes, lupine, rose, and snowberry, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Range seeding generally is not practical because of the stones in the surface layer and the slope. Forage production is limited by the low available water capacity in the Snell soil. The stones and the slope interfere with the installation of fences and watering facilities on the Snell soil.

The DeMasters soil is in capability subclass VIIe, nonirrigated. The Snell soil is in capability subclass VIs, nonirrigated.

27-Ewall loamy fine sand, 2 to 10 percent slopes. This very deep, excessively drained soil is on terraces. It formed in sandy eolian and glaciofluvial material. The native vegetation is mainly grasses. Elevation is 750 to 850 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

Typically, the upper 13 inches of the surface layer is dark grayish brown loamy fine sand. The underlying material to a depth of 60 inches or more is brown, grayish brown, and light brownish gray sand. The soil is calcareous below a depth of about 18 inches.

Permeability is very rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Included in this unit are areas of Chard loam and Ewall soils that have slopes of more than 10 percent. The included areas make up about 25 percent of the unit.

This unit is used for irrigated crops, irrigated hayland, pasture, homesite development, or wildlife habitat. The main limitations in the areas used for irrigated crops are the hazard of soil blowing, droughtiness, and low fertility. The main irrigated crops are alfalfa and grasses, grapes, and orchard crops. Sprinkler and trickle irrigation systems are suitable. Because the soil is droughty, light, frequent applications of irrigation water are needed. Water erosion and soil blowing in orchards can be controlled by growing perennial cover crops. Soil blowing can be controlled by properly managing all crop residue, minimizing tillage, and keeping the soil rough and cloddy when it is not protected by vegetation.

The main limitations in the areas used for irrigated hay and pasture are the low available water capacity and the hazard of water erosion during seedling establishment. Seeding forage crops on or nearly on the contour or across the slope helps to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seedling establishment.

This unit has few limitations in the areas used as homesites. These sites should be disturbed as little as possible. The main limitations on sites for septic tank absorption fields are a poor filtering capacity and the slope. If the density of housing is moderate or high, community sewage systems are needed to prevent the contamination of water supplies caused by seepage. Cutbanks are not stable and are subject to slumping. Establishing lawns is difficult in areas where the surface layer has been removed and the underlying material is exposed. Mulching and applying fertilizer in cut areas help to establish plants.

This unit is in capability subclass IVe, irrigated, and VIe, nonirrigated.

28-Ferdinand silty clay loam, 3 to 8 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and material weathered from basalt. The native vegetation is mainly grasses. Elevation is 3,000 to 3,600 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is very dark gray silty clay loam about 7 inches thick. The upper 9 inches of the subsoil is dark grayish brown very gravelly silty clay loam and dark yellowish brown very gravelly silty clay. The lower 7 inches is brown very cobbly clay loam, which is underlain by basalt at a depth of about 23 inches. The depth to basalt ranges from 20 to 30 inches. The soil is calcareous below a depth of about 16 inches. In some areas the surface layer is silt loam or cobbly silty clay loam.

Permeability is slow. Available water capacity is low. The effective rooting depth is 20 to 30 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Neconda silty clay loam, Neconda silt loam, Geoconda silty clay loam, and Ferdinand soils that have basalt within a depth of 20 inches and slopes of more than 8 percent. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland, hayland, or pasture. The principal crops are wheat, barley, and oats and grass for seed. The main limitations affecting nonirrigated cropland are the hazard of water erosion, the low available water capacity, and stones and cobbles on or near the surface. Annual cropping of small grain results in the efficient use of soil moisture and allows storage of more winter precipitation the following year. The soil profile is normally fully recharged with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage is difficult because of the stones and cobbles on or near the surface.

Terraces reduce the length of slopes and help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Field diversions can intercept excess runoff and minimize gullying in areas where steeper soils are upslope from this soil. Stripcropping can help to control water erosion on long slopes.

The main limitation in areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seedling establishment.

This unit is in capability subclass IVe, nonirrigated.

29-Ferdinand Variant-Mallory Variant association, 8 to 70 percent slopes. This map unit is on terraces and terrace escarpments. The native vegetation is mainly grasses. Elevation is 1,800 to 3,000 feet. The average annual precipitation is 16 or 17 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 135 days.

This unit is about 50 percent Ferdinand Variant very cobbly clay loam, 8 to 40 percent slopes, and 25 percent Mallory Variant silt loam, 30 to 70 percent slopes. The Ferdinand Variant is on south-facing slopes, and the Mallory Variant is on north-facing slopes.

Included in this unit are eroded areas where the Ferdinand Variant has a surface layer of very cobbly clay and slopes of less than 8 percent. Also included are Mallory Variant soils that have slopes of more than 70 percent. The included areas make up about 25 percent of the unit.

The Ferdinand Variant is very deep and well drained. It formed in old alluvium that has a minor amount of loess in the upper part. Typically, the surface layer is brown very cobbly clay loam about 5 inches thick. The upper 18 inches of the subsoil is reddish brown very gravelly clay. The lower part to a depth of 60 inches or more is reddish brown *very* cobbly clay. The soil is calcareous below **a** depth of about 23 inches. In some areas the surface layer is cobbly or extremely cobbly clay loam.

Permeability is slow in the Ferdinand Variant. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Mallory Variant is very deep and well drained. It formed in loess over old alluvium. Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The upper 35 inches of the subsoil is brown very gravelly clay loam and reddish brown very gravelly clay. The lower part to a depth of 60 inches or more is reddish brown very cobbly clay. The soil is calcareous below a depth of about 46 inches. In some areas the surface layer is cobbly clay loam or very cobbly clay loam.

Permeability is slow in the Mallory Variant. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the moderate available water capacity of the Ferdinand Variant. The slope limits access by livestock and can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred forage plants, such as threeawn, milkvetch, lupine, and annual bromes, increases.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The main limitations affecting seeding are cobbles on the surface and the slope of the Ferdinand Variant. The very cobbly areas and the areas where slopes are more than 45 percent can be seeded aerially or with a hand seeder. Mechanical seeding is not practical where slopes are more than 45 percent. Wildlife populations vary on this unit. This variability can greatly affect the initial stocking rate.

The cobbles on the surface of the Ferdinand Variant and the slope interfere with the installation of fences and watering facilities. Steep slopes require intensive management, such as herding and close intervals between salting stations, trails, and watering facilities.

The Ferdinand Variant is in capability subclass VIs, nonirrigated. The Mallory Variant is in capability subclass VIIe, nonirrigated.

30-Geoconda silt loam, 3 to 5 percent slopes. This deep, well drained soil is on plateaus. It formed in loess, slope alluvium, and material weathered from basalt. The native vegetation is mainly grasses. Elevation is 3,000 to 3,600 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is dark grayish brown silt loam about 11 inches thick. The upper 12 inches of the subsoil is dark grayish brown silty clay. The next 25 inches is brown silty clay. The lower 8 inches is light gray gravelly loam, which is underlain by basalt at a depth of about 56 inches. The depth to basalt ranges from 40 to 60 inches. The soil is calcareous below a depth of about 23 inches. In some areas the surface layer is silty clay loam.

Permeability is slow. Available water capacity is very high. The effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Ferdinand silt loam and areas of Geoconda soils that have a surface layer of stony silty clay loam, a seasonal high water table that is perched above the subsoil, and slopes of more than 5 percent. Also included are areas where the depth to basalt is more than 60 inches. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland. The principal crops are wheat, barley, and oats and grass for seed. Water erosion is the main hazard. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IIe, nonirrigated.

31-Geoconda-Powwahkee complex, 3 to 6 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 3,200 to 3,600 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 120 days.

This unit is about 55 percent Geoconda silty clay loam and 25 percent Powwahkee silt loam. The Geoconda soil is in convex areas, and the Powwahkee soil is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Ferdinand silty clay loam and areas of Geoconda soils that have a surface layer of stony silty clay loam, a seasonal high water table that is perched above the subsoil, and slopes of more than 6 percent. Also included are some areas where the depth to basalt is 40 to more than 60 inches. The included areas make up about 20 percent of the unit.

The Geoconda soil is deep and well drained. It formed in loess, slope alluvium, and material weathered from basalt. Typically, the surface layer is very dark gray silty clay loam about 11 inches thick. The upper 14 inches of the subsoil is very dark gray and dark grayish brown silty clay. The next 29 inches is brown silty clay. The lower 3 inches is brown gravelly silty clay, which is underlain by basalt at a depth of about 57 inches. The depth to basalt ranges from 40 to 60 inches. The soil is calcareous below a depth of about 25 inches.

Permeability is slow in the Geoconda soil. Available water capacity is very high. The effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight.

The Powwahkee soil is very deep and well drained. It formed in loess. Typically, the upper 8 inches of the surface layer is dark grayish brown silt loam. The lower 14 inches is dark grayish brown silty clay loam. The upper 17 inches of the subsoil is brown silty clay loam. The next 16 inches is brown silty clay loam and brown and yellowish brown silty clay. The lower part to a depth of 60 inches or more is brown silty clay loam. The soil is calcareous below a depth of about 55 inches.

Permeability is moderately slow in the Powwahkee soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used as nonirrigated cropland. The principal crops are wheat, barley, and oats and grass for seed. Few limitations affect nonirrigated cropland. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IIe, nonirrigated.

32-Geoconda-Powwahkee complex, 8 to 15 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 3,200 to 3,600 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 120 days.

This unit is about 55 percent Geoconda silty clay loam and 25 percent Powwahkee silt loam. The Geoconda soil is in convex areas, and the Powwahkee soil is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Neconda silty clay loam, Ferdinand silty clay loam, and Geoconda soils that have a surface layer of stony silty clay loam, a seasonal high water table that is perched above the subsoil, and slopes of less than 8 percent or more than 15 percent. Also included are some areas where the depth to basalt is 40 to more than 60 inches. The included areas make up about 20 percent of the unit.

The Geoconda soil is deep and well drained. It formed in loess, slope alluvium, and material weathered from basalt. Typically, the surface layer is very dark gray silty clay loam about 11 inches thick. The upper 14 inches of the subsoil is very dark gray and dark grayish brown silty clay. The next 29 inches is brown silty clay. The lower 3 inches is brown gravelly silty clay, which is underlain by basalt at a depth of about 57 inches. The depth to basalt ranges from 40 to 60 inches. The soil is calcareous below a depth of about 25 inches.

Permeability is slow in the Geoconda soil. Available water capacity is very high. The effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Powwahkee soil is very deep and well drained. It formed in loess. Typically, the upper 8 inches of the surface layer is dark grayish brown silt loam. The lower 14 inches is dark grayish brown silty clay loam. The upper 17 inches of the subsoil is brown silty clay loam. The next 16 inches is brown silty clay loam and brown and yellowish brown silty clay. The lower part to a depth of 60 inches or more is brown silty clay loam. The soil is calcareous below a depth of about 55 inches.

Permeability is moderately slow in the Powwahkee soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as nonirrigated cropland. The principal crops are wheat, barley, and oats and grass for seed. The main hazard is water erosion. Growing annual grain increases the rate of water intake.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Diversion terraces can reduce the length of slopes. If seeded to grass, they help to prevent excessive runoff, concentrated flow, and rill erosion. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IIIe, nonirrigated.

33-Geoconda-Powwahkee complex, 15 to 30 percent slopes. This map unit is on hilltops. The native vegetation is mainly grasses. Elevation is 3,200 to 3,600 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 120 days.

This unit is about 55 percent Geoconda silty clay loam and 25 percent Powwahkee silt loam. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Neconda silty clay loam, Ferdinand silty clay loam, and Geoconda soils that have a surface layer of stony silty clay loam, a seasonal high water table that is perched above the subsoil, and slopes of less than 15 percent or more than 30 percent. Also included are some areas where the depth to basalt is 40 to more than 60 inches. The included areas make up about 20 percent of the unit.

The Geoconda soil is deep and well drained. It formed in loess, slope alluvium, and material weathered from basalt. Typically, the surface layer is very dark gray silty clay loam about 11 inches thick. The upper 14 inches of the subsoil is very dark gray and dark grayish brown silty clay. The next 29 inches is brown silty clay. The lower 3 inches is brown gravelly silty clay, which is underlain by basalt at a depth of about 57 inches. The depth to basalt ranges from 40 to 60 inches. The soil is calcareous below a depth of about 25 inches.

Permeability is slow in the Geoconda soil. Available water capacity is very high. The effective rooting depth is 40 to 60 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Powwahkee soil is very deep and well drained. It formed in loess. Typically, the upper 8 inches of the surface layer is dark grayish brown silt loam. The lower 14 inches is dark grayish brown silty clay loam. The upper 17 inches of the subsoil is brown silty clay loam. The next 16 inches is brown silty clay loam and brown and yellowish brown silty clay. The lower part to a depth of 60 inches or more is brown silty clay loam. The soil is calcareous below a depth of about 55 inches.

Permeability is moderately slow in the Powwahkee soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as nonirrigated cropland. The principal crops are wheat, barley, and oats and grass for seed. The main hazard is water erosion. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. Growing grasses or grasses and legumes in the rotation about 50 percent of the time helps to control water erosion and maintain tilth.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Dividing the field slopes into two or more cropping patterns helps to control water erosion on part of the slopes.

This unit is in capability subclass IVe, nonirrigated.

34-Getaway cobbly silt loam, 30 to 70 percent slopes. This deep, well drained soil is on north-facing mountainsides and canyon walls. It formed in loess, some volcanic ash, and colluvium and slope alluvium derived from weathered basalt. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface is covered with a mat of partly decomposed needles and twigs about 1 inch thick. The surface layer is dark grayish brown cobbly silt loam about 15 inches thick. The upper 15 inches of the subsoil is brown very cobbly silty clay loam. The lower 28 inches is yellowish brown very cobbly clay loam, which is underlain by basalt at a depth of about 58 inches. The depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is stony silt loam.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

Included in this unit are areas of Klicker stony silt loam, Snell stony silt loam, Harlow very stony silt loam, Rock outcrop, and Getaway soils that have slopes of more than 70 percent. Also included are some areas where basalt is at a depth of more than 60 inches. The included areas make up about 25 percent of the unit.

This unit is used as grazeable woodland or wildlife habitat. Douglas fir and ponderosa pine are the principal tree species. Western larch and grand fir are of limited extent. The habitat type is generally Douglas fir-ninebark. On the basis of a 50-year site curve, the mean site index is 67 for Douglas fir. On the basis of a 100-year site curve, it is 68 for ponderosa pine. The highest average growth rate in unmanaged, even-aged stands is 54 cubic feet per acre per year for Douglas fir at age 106 and 53 cubic feet per acre per year for ponderosa pine at age 50. In a typical basal area, however, the composition of Douglas fir and ponderosa pine is reduced by about 70 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting are the slope and occasional snowpack. During an average year, snowpack limits the use of equipment and restricts access from December through March. The slope restricts the use of wheeled and tracked skidding equipment. Generally, cable yarding systems are safer and result in less surface disturbance. Unsurfaced logging roads are slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit. Cut and fill slopes are easily eroded. Establishing a plant cover in these disturbed areas reduces the hazard of erosion. Building the roads on midslopes requires extensive cutting and filling, which remove land from production.

Equipment and logs on the surface when the soil is wet or moist result in a high degree of compaction and puddling. Steep yarding paths, skid trails, and firebreaks are subject to rifling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out cable yarding paths, properly timing their use, or using cable systems that lift logs entirely off the ground can reduce the hazard of erosion.

Seedling mortality is the main concern affecting the production of timber. Droughtiness in the surface layer reduces the seedling survival rate. Reforestation can be accomplished by planting Douglas fir or ponderosa pine seedlings. If seed trees are available, natural reforestation of Douglas fir and ponderosa pine occurs readily in cutover areas and reforestation of western larch occurs periodically.

The forest understory vegetation is mallow ninebark, pinegrass, common snowberry, and creambush oceanspray. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue, strawberry, and ninebark, decreases and the proportion of the less preferred plants, such as annual bromes, snowberry, and annual forbs, increases. Generally, the density of the overstory is the main factor that limits the kind and amount of vegetation. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding generally is not practical because of the cobbles on the surface and the slope. Steep areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. The cobbles and the slope interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIe, nonirrigated.

35-Getaway-Snell complex, 30 to 70 percent slopes. This map unit is on north-facing mountainsides and canyon walls. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

This unit is about 50 percent Getaway stony silt loam and 30 percent Snell stony loam. The Getaway soil is in slightly concave areas and on foot slopes, and the Snell soil is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included on this unit are areas of Klicker stony silt loam, Harlow very stony clay loam, Rock outcrop, and Getaway soils that have slopes of more than 70 percent. Also included are some areas where the depth to basalt is more than 60 inches. The included areas make up about 20 percent of the unit.

The Getaway soil is deep and well drained. It formed in loess, some volcanic ash, and colluvium and slope alluvium derived from weathered basalt. Typically, the surface is covered with a mat of partly decomposed needles and twigs about 1 inch thick. The upper 4 inches of the surface layer is dark grayish brown stony silt loam. The lower 11 inches is dark grayish brown cobbly silt loam. The upper 15 inches of the subsoil is brown very cobbly silty clay loam. The lower 20 inches is yellowish brown very cobbly clay loam, which is underlain by basalt at a depth of about 58 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderately slow in the Getaway soil. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Snell soil is moderately deep and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the upper 6 inches of the surface layer is *very* dark grayish brown stony loam. The lower 6 inches is dark grayish brown very gravelly clay loam. The subsoil is about 13 inches of dark grayish brown very cobbly clay loam and dark brown very cobbly clay, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is moderately slow in the Snell soil. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as grazeable woodland or wildlife habitat. Douglas fir and ponderosa pine are the principal tree species on the Getaway soil. Western larch and grand fir are of limited extent. The habitat type is generally Douglas fir-ninebark. On the basis of a 50-year site curve, the mean site index is 67 for Douglas fir on the Getaway soil. On the basis of a 100-year site curve, it is 68 for ponderosa pine. The highest average growth rate in unmanaged, even-aged stands is 54 cubic feet per acre per year for Douglas-fir at age 106 and 53 cubic feet per acre per year for ponderosa pine at age 50. In a typical basal area of the Getaway soil, however, the composition of Douglas fir and ponderosa pine is reduced by about 70 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting on the Getaway soil are the slope and occasional snowpack. During an average year, snowpack limits the use of equipment and restricts access from December through March. The slope restricts the use of wheeled and tracked skidding equipment. Generally, cable yarding systems are safer and result in less surface disturbance. Unsurfaced logging roads are slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit. Cut and fill slopes are easily eroded. Establishing a plant cover in these disturbed areas reduces the hazard of erosion. Building the roads on midslopes requires extensive cutting and filling, which remove land from production.

Equipment and logs on the surface can result in a high degree of compaction when the Getaway soil is wet or moist and a high degree of puddling when the soil is wet. Steep yarding paths, skid trails, and firebreaks are subject to rifling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out cable yarding paths, properly timing their use, or using cable systems that lift logs entirely off the ground can reduce the hazard of erosion. Seedling mortality on the Getaway soil is the main concern affecting the production of timber. Droughtiness in the surface layer reduces the seedling survival rate. Reforestation can be accomplished by planting Douglas fir and ponderosa pine seedlings. If seed trees are available, natural reforestation of Douglas fir and ponderosa pine occurs readily in cutover areas and reforestation of western larch occurs periodically.

The forest understory vegetation on the Getaway soil is mallow ninebark, pinegrass, common snowberry, and creambush oceanspray. The potential native vegetation on the Snell soil is Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue and bluebunch wheatgrass, decreases and the proportion of less preferred plants, such as annual bromes, lupine, annual forbs, and snowberry, increases. Generally, the density of the overstory is the main factor that limits the kind and amount of vegetation on the Getaway soil. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The slope limits access by livestock and thus can result in overgrazing of the less sloping areas. The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Mechanical seeding generally is not practical because of the stones in the surface layer and the slope. Steep areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. The stones and the slope interfere with the installation of fences and watering facilities.

The Getaway soil is in capability subclass VIIe, nonirrigated. The Snell soil is in capability subclass VIs, nonirrigated.

36-Gwinly-Mallory complex, 3 to 30 percent slopes. This map unit is on shoulder slopes. The native vegetation is mainly grasses. Elevation is 3,000 to 3,600 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 110 to 135 days.

This unit is about 40 percent Gwinly very stony silt loam and 35 percent Mallory stony silt loam. The Gwinly soil is in convex areas, and the Mallory soil is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Ferdinand silt loam and Gwinly soils that have slopes of more than 30 percent. The included areas make up about 25 percent of the unit.

The Gwinly soil is shallow and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the surface layer is very dark grayish brown very stony silt loam about 3 inches thick. The upper 8 inches of the subsoil is very dark grayish brown very cobbly clay loam. The lower 4 inches is dark grayish brown extremely cobbly clay, which is underlain by basalt at a depth of about 15 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Gwinly soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Mallory soil is moderately deep and well drained. It formed in loess, slope alluvium, and colluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is very dark grayish brown stony silt loam. The lower 5 inches is very dark grayish brown very cobbly clay loam. The subsoil is about 16 inches of dark grayish brown very cobbly clay and dark brown extremely cobbly clay, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is very stony silt loam.

Permeability is slow in the Mallory soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low or low available water capacity.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning.

The main limitations affecting seeding are the stones and the low or very low available water capacity. Broadcast seeding with aerial equipment or a hand seeder is the most effective method of seeding. Some areas of the Mallory soil could be reseeded with a rangeland drill. The stones on both soils and the shallowness of the Gwinly soil interfere with the installation of fences and watering facilities.

The Gwinly soil is in capability subclass VIIs, nonirrigated. The Mallory soil is in capability subclass VIe, nonirrigated.

37-Gwinly-Mallory very stony silt loams, 30 to 70 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 2,400 to 4,100 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 110 to 135 days.

This unit is about 40 percent Gwinly very stony silt loam and 35 percent Mallory very stony silt loam. The Gwinly soil is in convex areas, and the Mallory soil is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Lawyer stony silt loam, Rock outcrop, Rockly extremely stony loam, and Gwinly soils that have slopes of more than 70 percent.

Also included are areas of Bridgewater extremely stony sandy loam on alluvial fans and flood plains. The included areas make up about 25 percent of the unit.

The Gwinly soil is shallow and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown very stony silt loam about 3 inches thick. The upper 8 inches of the subsoil is dark grayish brown very cobbly silty clay loam. The lower 4 inches is brown extremely cobbly clay, which is underlain by basalt at a depth of about 15 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Gwinly soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Mallory soil is moderately deep and well drained. It formed in loess and slope alluvium and colluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark brown very stony silt loam. The lower 5 inches is dark brown very cobbly clay loam. The subsoil is about 16 inches of dark brown very cobbly and extremely cobbly clay, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is slow in the Mallory soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low or very low available water capacity.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Range seeding generally is not practical because of the stoniness and the slope. The very low or low available water capacity is an additional limitation. The shallowness of the Gwinly soil and the stones in the surface layer and slope of both soils interfere with the installation of fences and watering facilities.

The Gwinly soil is in capability subclass VIIe, nonirrigated. The Mallory soil is in capability subclass VIIs, nonirrigated.

38-Gwinly-Mallory-Rock outcrop complex, 40 to 90 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 2,400 to 4,100 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 110 to 135 days.

This unit is about 35 percent Gwinly very stony silt loam, 30 percent Mallory very stony silt loam, and 15 percent Rock outcrop. The Gwinly soil and the Rock outcrop are in convex areas, and the Mallory soil is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Lawyer stony silt loam, Rockly extremely stony loam, and Gwinly soils that have slopes of more than 90 percent. Also included are areas of Bridgewater extremely stony sandy loam on flood plains and alluvial fans. The included areas make up about 20 percent of the unit.

The Gwinly soil is shallow and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the surface layer is about 3 inches of dark grayish brown very stony silt loam. The upper 8 inches of the subsoil is dark grayish brown very cobbly clay loam. The lower 4 inches is brown extremely cobbly clay, which is underlain by basalt at a depth of about 15 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Gwinly soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Mallory soil is moderately deep and well drained. It formed in loess, slope alluvium, and colluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark brown very stony silt loam. The lower 5 inches is dark brown very cobbly clay loam. The subsoil is about 16 inches of dark brown very cobble and extremely cobbly clay, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is slow in the Mallory soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low or very low available water capacity. The slope and the Rock outcrop limit access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue on the Gwinly soil and Sandberg bluegrass, bluebunch wheatgrass, Idaho fescue, and stiff sagebrush on the Mallory soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Range seeding is not practical because of the stoniness, the slope, and the very low or low available water capacity. The stones, the shallowness to bedrock, and the slope interfere with the installation of fences and watering facilities.

The Gwinly soil is in capability subclass VIIe, nonirrigated. The Mallory soil is in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

39-Gwinly-Rockly-Rock outcrop complex, 60 to 120 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 1,400 to 4,100 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 110 to 135 days.

This unit is about 40 percent Gwinly very stony silt loam, 25 percent Rockly extremely stony silt loam, and 20 percent Rock outcrop. The Gwinly soil is in concave areas, and the Rockly soil and Rock outcrop are in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Lawyer very stony silt loam, Mallory very stony loam, and Rockly soils that have slopes of more than 120 percent. The included areas make up about 15 percent of the unit.

The Gwinly soil is shallow and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown very stony silt loam about 3 inches thick. The upper 8 inches of the subsoil is dark grayish brown very cobbly clay loam. The lower 4 inches is brown extremely cobbly clay, which is underlain by basalt at a depth of about 15 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Gwinly soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rockly soil is very shallow and well drained. It formed in material weathered from basalt and in some loess. Typically, the surface layer is brown extremely stony loam about 3 inches thick. The subsoil is about 6 inches of brown very cobbly loam and extremely cobbly clay loam, which is underlain by basalt at a depth of about 9 inches. The depth to basalt ranges from 4 to 10 inches.

Permeability is moderately slow in the Rockly soil. Available water capacity is very low. The effective rooting depth is 4 to 10 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as wildlife habitat or rangeland. The production of vegetation is limited by the low or very low available water capacity. The slope and the Rock outcrop limit access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass on the Gwinly soil and Sandberg bluegrass, bluebunch wheatgrass, Idaho fescue, and stiff sagebrush on the Rockly soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Range seeding generally is not practical because of the stoniness, the slope, and the very low or low available water capacity. The stones, the shallowness to bedrock, and the slope interfere with the installation of fences and watering facilities.

The Gwinly soil is in capability subclass VIIe, nonirrigated. The Rockly soil is in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

40-Gwinly-Tamming complex, 30 to 70 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 1,800 to 4,000 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 100 to 125 days

This unit is about 40 percent Gwinly very stony silt loam and 35 percent Tamming stony silt loam. The Gwinly soil is in convex areas, and the Tamming soil is in concave areas and on foot slopes. Areas of the Gwinly soil generally are more than 100 acres in size, and areas of the Tamming soil generally are 20 to 40 acres in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Mallory very stony silt loam, Rock outcrop, and areas where basalt is at a depth of more than 60 inches. Also included are areas of Bridgewater Variant stony loam on flood plains. The included areas make up about 25 percent of the unit.

The Gwinly soil is shallow and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown very stony silt loam about 3 inches thick. The upper 8 inches of the subsoil is dark grayish brown very cobbly clay loam. The lower 4 inches is brown extremely cobbly clay, which is underlain by basalt at a depth of about 15 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Gwinly soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Tamming soil is deep and well drained. It formed in colluvium derived from loess, weathered basalt, and some volcanic ash. Typically, the surface is covered with a mat of partly decomposed needles and twigs about 1 inch thick. The upper 4 inches of the surface layer is dark grayish brown stony silt loam. The lower 7 inches is brown very gravelly silt loam. The upper 11 inches of the subsoil is brown very gravelly silty clay loam. The lower 22 inches is brown very gravelly and extremely cobbly clay loam, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderately slow in the Tamming soil. Available water capacity is moderate. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as grazeable woodland or wildlife habitat. The production of vegetation is limited because of the very low available water capacity of the Gwinly soil.

The potential native vegetation on the Gwinly soil is bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue. The forest understory vegetation on the Tamming soil is bluebunch wheatgrass, common snowberry, and Oregongrape. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as annual bromes, snowberry, dogbane, and annual forbs, increases. Generally, the density of the overstory is the main factor that limits the kind and amount of vegetation on the Tamming soil. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding generally is not practical because of the stoniness of the surface layer and the slope. The very low available water capacity of Gwinly soil also is a limitation. Steep areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. The shallowness of the Gwinly soil and the surface stoniness and slope of both soils interfere with the installation of fences and watering facilities.

Ponderosa pine is the principal tree species on the Tamming soil. The habitat type is generally ponderosa pine-snowberry. On the basis of a 100-year site curve, the mean site index is 91 for ponderosa pine. The highest average growth rate in unmanaged, even-aged stands is 87 cubic feet per acre per year for ponderosa pine at age 40. In a typical basal area, however, the composition of ponderosa pine is reduced by about 30 percent and growth rates are reduced accordingly.

The main limitation affecting timber harvesting is the slope of the Tamming soil. The slope restricts the use of wheeled and tracked skidding equipment. Generally, cable yarding systems are safer and result in less surface disturbance. Unsurfaced roads are sticky and slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit. Cut and fill slopes are easily eroded. Establishing a plant cover in these disturbed areas reduces the hazard of erosion. Building the roads on midslopes requires extensive cutting and filling, which remove land from production.

Equipment and logs on the surface when the Tamming soil is wet can result in a moderate degree of puddling. Steep yarding paths, skid trails, and firebreaks are subject to rifling and gullying unless protected by adequate water bars or a plant cover. Avoiding rock outcrop results in the convergence of yarding paths and skid trails, which increases the hazards of compaction and erosion. Carefully laying out cable yarding paths, properly timing their use, or using a cable system that lifts logs entirely off the ground can reduce the hazards of puddling and erosion. A moderate reduction in soil productivity can result from unmanaged fires in undisturbed areas.

Seedling establishment is the main concern affecting the production of timber. Droughtiness in the surface layer reduces the seedling survival rate. Reforestation can be accomplished by planting ponderosa pine seedlings. Planting the seedlings is difficult because of the stones. If seed trees are available, natural reforestation of ponderosa pine occurs readily in cutover areas. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy.

This unit is in capability subclass VIIe, nonirrigated.

41-Harlow-Getaway complex, 30 to 70 percent slopes. This map unit is on north-facing mountain slopes and canyon walls. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 18 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

This unit is about 40 percent Harlow very stony clay loam and 35 percent Getaway stony silt loam. The Harlow soil is in convex areas, and the Getaway soil is in concave areas and on foot slopes. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Klicker stony silt loam, Snell stony silt loam, Rock outcrop, and Harlow soils that have slopes of more than 70 percent. Also included are areas of Bridgewater Variant stony loam on flood plains and areas where the depth to basalt is more than 60 inches. The included areas make up about 25 percent of the unit.

The Harlow soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 3 inches of the surface layer is dark grayish brown very stony clay loam. The lower 3 inches is dark grayish brown very gravelly clay loam. The subsoil is about 12 inches of dark grayish brown very cobbly clay loam and dark brown very cobbly clay, which is underlain by basalt at a depth of about 18 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Harlow soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Getaway soil is deep and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt and in some volcanic ash. Typically, the surface is covered with a mat of partly decomposed needles and twigs about 1 inch thick. The upper 4 inches of the surface layer is dark grayish brown stony silt loam. The lower 11 inches is dark grayish brown very cobbly silt loam. The upper 15 inches of the subsoil is brown very cobbly silty clay loam. The lower 28 inches is yellowish brown very cobbly clay loam, which is underlain by basalt at a depth of about 58 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderately slow in the Getaway soil. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as grazeable woodland or wildlife habitat. The production of vegetation is limited because of the very low available water capacity of the Harlow soil. The extent of the overstory is limited on the Getaway soil. Proper management of livestock grazing is needed to prevent excessive erosion.

The potential native vegetation on the Harlow soil is Idaho fescue, bluebunch wheatgrass, and prairie junegrass. The forest understory vegetation on the Getaway soil is mallow ninebark, pinegrass, common snowberry, and creambush oceanspray. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred forage plants, such as snowberry, lupine, yarrow, and annual forbs, increases. Generally, the density of the overstory is the main factor that limits the kind and amount of vegetation. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding generally is not practical because of the stoniness of the surface layer and the slope. The very low available water capacity of the Harlow soil also is a limitation. Steep areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock. The limited depth and stoniness of the Harlow soil and the slope of both soils interfere with the installation of fences and watering facilities.

Douglas fir and ponderosa pine are the principal tree species on the Getaway soil. Western larch and grand-fir are of limited extent. The habitat type is generally Douglas fir-ninebark. On the basis of a 50-year site curve, the mean site index is 67 for Douglas fir. On the basis of a 100-year site curve, it is 68 for ponderosa pine. The highest average growth rate in unmanaged, even-aged stands is 54 cubic feet per acre per year for Douglas fir at age 106 and 53 cubic feet per acre per year for ponderosa pine at age 50. In a typical basal area, however, the composition of Douglas fir and ponderosa pine is reduced by about 70 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting are the slope and occasional snowpack on the Getaway soil. During an average year, snowpack limits the use of equipment and restricts access from December through March. The slope restricts the use of wheeled and tracked skidding equipment. Generally, cable yarding systems are safer and result in less surface disturbance. Unsurfaced logging roads are slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit. Cut and fill slopes are easily eroded. Establishing a plant cover in these disturbed areas reduces the hazard of erosion. Building the roads on midslopes requires extensive cutting and filling, which remove land from production.

Equipment and logs on the surface when the Getaway soil is wet or moist can result in a high degree of compaction and puddling. Steep yarding paths, skid trails, and firebreaks are subject to rifling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out cable yarding paths, properly timing their use, or using cable systems that lift logs entirely off the ground can reduce the hazards of compaction, puddling, and erosion.

Seedling mortality is the main concern affecting the production of timber on the Getaway soil. Droughtiness in the surface layer reduces the seedling survival rate. Reforestation can be accomplished by planting Douglas fir or ponderosa pine seedlings. If seed trees are available, natural reforestation of Douglas fir and ponderosa pine occurs readily in cutover areas and reforestation of western larch occurs periodically.

The Harlow soil is in capability subclass VIIs, nonirrigated. The Getaway soil is in capability subclass VIIe, nonirrigated.

42-Harlow-Getaway complex, 30 to 70 percent south slopes. This map unit is on south-facing mountain slopes and canyon walls. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

This unit is about 40 percent Harlow very stony clay loam and 35 percent Getaway very stony silt loam. The Harlow soil is in convex areas, and the Getaway soil is in concave areas and on foot slopes. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Klicker very stony silt loam, Snell *very* stony clay loam, Rock outcrop, and Harlow soils that have slopes of more than 70 percent. Also included are areas of Bridgewater Variant stony loam on flood plains and areas where the depth to basalt is more than 60 inches. The included areas make up about 25 percent of the unit.

The Harlow soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 3 inches of the surface layer is brown very stony clay loam. The lower 3 inches is brown very gravelly clay loam. The subsoil is about 8 inches of brown very cobbly clay loam and extremely cobbly clay, which is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Harlow soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Getaway soil is deep and well drained. It formed in loess, colluvium, slope alluvium derived from weathered basalt, and some volcanic ash. Typically, the surface is covered with a mat of partly decomposed needles and twigs about 1 inch thick. The upper 4 inches of the surface layer is brown very stony silt loam. The lower 7 inches is brown very gravelly loam. The upper 11 inches of the subsoil is brown very gravelly silt loam. The lower 22 inches is brown very cobbly clay loam, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderately slow in the Getaway soil. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as grazeable woodland or wildlife habitat. The production of vegetation is limited by the very low available water capacity in the Harlow soil and the hazard of water erosion.

The potential native vegetation on the Harlow soil is bluebunch wheatgrass, Idaho fescue, and balsamroot. The forest understory vegetation on the Getaway soil is mallow ninebark, pinegrass, common snowberry, and creambush oceanspray. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred forage plants, such as annual bromes, lupine, yarrow, and snowberry, increases. Generally, the density of the overstory is the main factor that limits the kind and amount of forage on the Getaway soil. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding generally is not practical because of the stoniness and the slope. The very low available water capacity of the Harlow soil also is a limitation. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. The shallowness of the Harlow soil and the surface stoniness and slope of both soils interfere with the installation of fences and watering facilities.

Ponderosa pine and Douglas fir are the principal tree species on the Gateway soil. Western larch is of limited extent. The habitat is typically Douglas fir-ninebark. On the basis of a 100-year site curve, the mean site index is 88 for ponderosa pine. On the basis of a 50-year site curve, it is 61 for Douglas fir. The highest average growth rate in unmanaged, even-aged stands is 82 cubic feet per acre per year for ponderosa pine at age 40 and 46 cubic feet per acre per year for Douglas fir at age 109. In a typical basal area, however, the composition of ponderosa pine is reduced by about 50 percent and the composition of Douglas fir is reduced by about 80 percent. Growth rates are reduced accordingly.

The main limitations affecting timber harvesting are the slope and occasional snowpack. During an average year, snowpack limits the use of equipment and restricts access from December through February. The slope restricts the use of wheeled and tracked skidding equipment. Generally, cable yarding systems are safer and result in less surface disturbance. Unsurfaced logging roads are slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit. Cut and fill slopes are easily eroded. Establishing a plant cover in these disturbed areas reduces the hazard of erosion. Building the roads on midslopes requires extensive cutting and filling, which remove land from production.

Equipment and logs on the surface when the soil is wet or moist can result in a high degree of compaction and puddling. Steep yarding paths, skid trails, and firebreaks are subject to rifling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out cable yarding paths, properly timing their use, or using cable systems that lift logs entirely off the ground can reduce the hazards of compaction, puddling, and erosion.

Seedling mortality is the main concern affecting the production of timber. Droughtiness in the surface layer reduces the seedling survival rate. Reforestation can be accomplished by planting ponderosa pine or Douglas fir seedlings. If seed trees are available, natural reforestation of ponderosa pine and Douglas fir occurs readily in cutover areas.

This map unit is in capability subclass VIIs, nonirrigated.

43-Harlow-Getaway-Rock outcrop complex, 60 to 90 percent slopes. This map unit is on north-facing mountain slopes and canyon walls. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

This unit is about 35 percent Harlow very stony clay loam, 30 percent Getaway stony silt loam, and 15 percent Rock outcrop. The Harlow soil and the Rock outcrop are in convex areas, and the Getaway soil is in concave areas and on foot slopes. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Klicker stony silt loam, Snell stony silt loam, and Harlow soils that have slopes of less than 60 percent or more than 90 percent. Also included are areas of Bridgewater Variant stony loam on flood plains and areas where the depth to basalt is more than 60 inches. The included areas make up about 20 percent of the unit.

The Harlow soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 3 inches of the surface layer is dark grayish brown very stony clay loam. The lower 3 inches is dark grayish brown very gravelly clay loam. The subsoil is about 12 inches of dark grayish brown very cobbly clay loam and dark brown very cobbly clay, which is underlain by basalt at a depth of about 18 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Harlow soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Getaway soil is deep and well drained. It formed in loess, some volcanic ash, colluvium, and slope alluvium derived from weathered basalt. Typically, the surface is covered with a mat of partly decomposed needles and twigs about 1 inch thick. The upper 4 inches of the surface layer is dark grayish brown stony silt loam. The lower 11 inches is dark grayish brown cobbly silt loam. The upper 15 inches of the subsoil is brown very cobbly silty clay loam. The lower 28 inches is yellowish brown very cobbly clay loam, which is underlain by basalt at a depth of about 58 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderately slow in the Getaway soil. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as wildlife habitat or grazeable woodland. The production of vegetation is limited by the very low available water capacity and hazard of water erosion in areas of the Harlow soil. The slope and the Rock outcrop limit access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation on the Harlow soil is Idaho fescue, bluebunch wheatgrass, and prairie junegrass. The forest understory vegetation on the Getaway soil is mallow ninebark, pinegrass, common snowberry, and creambush oceanspray. If the vegetation is overgrazed, the proportion of the preferred plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred forage plants, such as annual bromes, lupine, and snowberry, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Range seeding generally is not practical because of the stones and the slope. The very low available water capacity of the Harlow soil also is a limitation. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. The surface stones, the shallowness of the Harlow soil, and the slope interfere with the installation of fences and watering facilities.

Douglas fir and ponderosa pine are the principal tree species on the Getaway soil. Western larch and grand fir are of limited extent. The habitat type is generally Douglas fir-ninebark. On the basis of a 50-year site curve, the mean site index is 67 for Douglas fir. On the basis of a 100-year site curve, it is 68 for ponderosa pine. The highest average growth rate in unmanaged, even-aged stands is 54 cubic feet per acre per year for Douglas fir at age 106 and 53 cubic feet per acre per year for ponderosa pine at age 50. In a typical basal area, however, the composition of Douglas fir and ponderosa pine is reduced by about 70 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting are the slope and occasional snowpack on the Getaway soil. During an average year, snowpack limits the use of equipment and restricts access from December through March. Cable yarding systems generally are used on this unit. Unsurfaced logging roads are slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit. Cut and fill slopes are easily eroded. Establishing a plant cover in these disturbed areas reduces the hazard of erosion. Building the roads on midslopes requires extensive cutting and filling, which remove land from production.

Equipment and logs on the surface when the soil is wet or moist can result in a high degree of compaction and puddling on the Getaway soil. Steep yarding paths, skid trails, and firebreaks are subject to rifling and gullying unless protected by adequate water bars or a plant cover. Avoiding rock outcrop results in the convergence of yarding paths and skid trails, which increases the hazards of compaction and erosion. Carefully laying out cable yarding paths, properly timing their use, or using cable systems that lift logs entirely off the ground can reduce the hazards of compaction, puddling, and erosion.

Seedling mortality on the Getaway soil is the main concern affecting the production of timber. Droughtiness in the surface layer reduces the seedling survival rate. Reforestation can be accomplished by planting Douglas fir and ponderosa pine seedlings. If seed trees are available, natural reforestation of Douglas fir and ponderosa pine occurs readily in cutover areas and reforestation of western larch occurs periodically.

The Harlow soil is in capability subclass VIIs, nonirrigated. The Getaway soil is in capability subclass VIIe, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

44-Harlow-Snell very stony clay foams, 30 to 70 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 4,000 to 4,800 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 115 days.

This unit is about 40 percent Harlow very stony clay loam and 35 percent Snell very stony clay loam. The Harlow soil is in convex areas, and the Snell soil is in slightly concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Harlow soils that have slopes of more than 70 percent and soils that have basalt at a depth of more than 40 inches. Also included are areas of Bridgewater Variant stony loam on flood plains. The included areas make up about 25 percent of the unit.

The Harlow soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 3 inches of the surface layer is dark grayish brown very stony clay loam. The lower 3 inches is dark grayish brown very gravelly clay loam. The subsoil is about 8 inches of brown very cobbly clay loam and brown extremely cobbly clay, which is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Harlow soil. Available water capacity is very low. The effective rooting depth is

10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Snell soil is moderately deep and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the upper 6 inches of the surface layer is dark grayish brown very stony clay loam. The lower 6 inches is dark grayish brown very gravelly clay loam. The subsoil is about 13 inches of brown very cobbly clay loam and extremely cobbly clay, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is moderately slow in the Snell soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low or very low available water capacity and the short growing season. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas. Proper management of livestock grazing is needed to prevent excessive erosion.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and balsamroot. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass and annual forbs, increases. Areas that have an excessive number of undesirable shrubs and weeds can be improved by chemical treatment.

Mechanical seeding generally is not practical because of the stoniness and the slope. The very low or low available water capacity also is a limitation. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The surface stones, the shallowness to bedrock, and the slope interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIs, nonirrigated.

45-Harlow-Snell-Harlow Variant complex, 3 to 30 percent slopes. This map unit is on shoulder slopes and ridgetops. The native vegetation is mainly grasses. Elevation is 3,400 to 5,000 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 115 days.

This unit is about 35 percent Harlow very stony clay loam, 25 percent Snell silty clay loam, and 25 percent Harlow Variant very stony loam. The Harlow soil and the Harlow Variant are in irregularly shaped areas between mounds and in convex areas. The Snell soil is on small circular mounds and in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Snell soils that have a surface layer of very stony clay loam or silty clay loam and Snell soils that have basalt at a depth of more than 40 inches. Also included are Harlow soils that have slopes of more than 30 percent. The included areas make up about 15 percent of the unit.

The Harlow soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 3 inches of the surface layer is very dark grayish brown very gravelly clay loam. The lower 3 inches is very dark grayish brown very stony clay loam. The subsoil is about 8 inches of brown very cobbly clay loam and extremely cobbly clay, which is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Harlow soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Snell soil is moderately deep and well drained. It formed in loess and in colluvium derived from weathered basalt. Typically, the upper 7 inches of the surface layer is very dark grayish brown silty clay loam. The lower 4 inches is very dark grayish brown gravelly silty clay loam. The upper 5 inches of the subsoil is dark grayish brown gravelly silty clay. The lower 7 inches is brown very gravelly silty clay, which is underlain by basalt at a depth of about 23 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is moderately slow in the Snell soil. Available water capacity is low. The effective rooting depth is 20 to 30 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Harlow Variant is very shallow and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the upper 2 inches of the surface layer is dark grayish brown very stony loam. The lower 3 inches is dark brown *very* gravelly loam. The subsoil is about 4 inches of dark brown extremely cobbly clay loam, which is underlain by basalt at a depth of about 9 inches. The depth to basalt ranges from 5 to 10 inches. In some areas the surface layer is very cobbly loam.

Permeability is moderate in the Harlow Variant. Available water capacity is very low. The effective rooting depth is 5 to 10 inches. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low or very low available water capacity and the short growing season. The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, lupine, yarrow, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning.

The main limitations affecting range seeding are the stoniness and the very low or low available water capacity. Broadcast seeding with aerial equipment or a hand seeder is the most effective method of seeding. Some areas of the Snell soil could be reseeded with a rangeland drill. The shallowness and stoniness of the Harlow and Harlow Variant soils interfere with the installation of fences and watering facilities.

The Harlow and Harlow Variant soils are in capability subclass VIIs, nonirrigated. The Snell soil is in capability subclass IVe, nonirrigated.

46-Harlow-Snell-Rock outcrop complex, 40 to 90 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 4,000 to 4,800 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 115 days.

This unit is about 35 percent Harlow very stony clay loam, 30 percent Snell very stony clay loam, and 15 percent Rock outcrop. The Harlow soil and the Rock outcrop are in convex areas, and the Snell soil is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Harlow soils that have slopes of more than 90 percent and areas where basalt is at a depth of more than 40 inches. The included areas make up about 20 percent of the unit.

The Harlow soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 3 inches of the surface layer is dark brown very stony clay loam. The lower 3 inches is dark brown very gravelly clay loam. The subsoil is about 8 inches of reddish brown very cobbly clay loam and extremely cobbly clay, which is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Harlow soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Snell soil is moderately deep and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark brown very stony clay loam. The lower 4 inches is dark brown very gravelly clay loam. The subsoil is about 17 inches of reddish brown very cobbly clay loam and extremely cobbly clay, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is moderately slow in the Snell soil. Available water capacity is very low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low available water capacity, the stones on the surface, the short growing season, and the Rock outcrop. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred forage plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding generally is not practical because of the stoniness, the slope, and the Rock outcrop. The very low available water capacity also is a limitation. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The surface stones, the shallowness of the Harlow soil, and the slope interfere with the installation of fences and watering facilities.

The Harlow and Snell soils are in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

47-Joseph extremely cobbly loamy sand, 0 to 3 percent slopes. This very deep, moderately well drained soil is on flood plains. It is subject to frequent flooding from December through June. It formed in basaltic alluvium. The native vegetation is mainly sparse shrubs and grasses. Elevation is 750 to 1,600 feet. The average annual precipitation is 12 to 19 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 120 to 150 days.

Typically, the surface layer is dark grayish brown extremely cobbly loamy sand about 9 inches thick. The underlying material to a depth of 60 inches or more is dark gray extremely cobbly sand. In some areas the surface layer is extremely stony or extremely gravelly loamy sand.

Permeability is very rapid. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The seasonal high water table is at a depth of 36 to 60 inches during the period December through June.

Included in this unit are areas of soils that have a surface layer of extremely stony sandy loam, areas of well drained soils, and Joseph soils that have slopes of more than 3 percent. The included areas make up about 20 percent of the unit.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by early season flooding and later season droughtiness.

The potential native vegetation is willow, American licorice, and slender wheatgrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as slender wheatgrass and American licorice, decreases and the proportion of the less preferred forage plants, such as Scotch cottonthistle. Jim Hill mustard, dogbane, knapweed, yellow starthistle, and other annual forbs, increases.

The main limitations affecting livestock grazing and range seeding are inaccessibility in some areas and the cobbles in the surface layer. The unit can be seeded aerially or with a hand seeder. The flooding and the cobbles interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIw, nonirrigated.

48-Klicker very stony silt loam, 3 to 30 percent slopes. This moderately deep, well drained soil is on ridgetops, plateaus, and benches. It formed in loess and slope alluvium and colluvium derived from weathered basalt. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the upper 4 inches of the surface layer is dark brown very stony silt loam. The lower 7 inches is dark brown very cobbly silt loam. The subsoil is about 14 inches of dark brown extremely cobbly clay loam, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is moderately slow. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

Included in this unit are areas of Harlow very stony clay loam, Snell very stony clay loam, Sweiting silt loam, and Klicker soils that have slopes of more than 30 percent. The included areas make up about 25 percent of the unit.

This unit is used as grazeable woodland or wildlife habitat. Ponderosa pine is the principal tree species. Douglas fir is of limited extent. The habitat type is generally ponderosa pine-snowberry. On the basis of a 100-year site curve, the mean site index is 78 for ponderosa pine. The highest average growth rate in unmanaged, even-aged stands is 66 cubic feet per acre per year for ponderosa pine at age 40. In a typical basal area, however, the composition of ponderosa pine is reduced by about 65 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting are the stoniness and the muddiness caused by seasonal wetness. The stones on the surface hinder harvesting activities. When felled, the timber can break on the stones. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced logging roads are sticky and slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit.

Equipment and logs on the surface can result in a high degree of compaction and puddling when the soil is wet or moist and a moderate degree of displacement when the soil is dry. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, displacement, and erosion. A moderate reduction in soil productivity can result from unmanaged fires in undisturbed areas.

Seedling establishment is the main concern affecting the production of timber. Droughtiness in the surface layer reduces the seedling survival rate. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are available, natural reforestation of ponderosa pine occurs readily in cutover areas and reforestation of Douglas fir occurs periodically. Because the rooting depth is restricted by the underlying bedrock, trees are occasionally subject to windthrow if the soil is wet and winds are strong. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means.

The forest understory vegetation is common snowberry, bluebunch wheatgrass, elk sedge, and pinegrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue, decreases and the proportion of the less preferred plants, such as spirea, snowberry, and annual

Figure 4.-An area of Laufer-Rockly-Rock outcrop complex, 60 to 120 percent slopes. Horizontal layers of Rock outcrop are on south-facing slopes.

forbs, increases. Generally, the density of the overstory is the main factor that limits the kind and amount of understory vegetation. The stones in the soil profile interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIs, nonirrigated.

49-Laufer-Rockly-Rock outcrop complex, 60 to 120 percent slopes. This map unit is on south-facing canyon walls (fig. 4). The native vegetation is mainly grasses. Elevation is 1,200 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

This unit is about 40 percent Laufer very stony clay loam, 25 percent Rockly extremely stony loam, and 20 percent Rock outcrop. The Laufer soil is in concave areas, the Rockly soil is in small convex areas, and the Rock outcrop is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Lawyer very stony silt loam, Thiessen very stony silt loam, and Laufer soils that have slopes of less than 60 percent. The included areas make up about 15 percent of the unit.

The Laufer soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the surface layer is brown very stony clay loam about 3 inches thick. The upper 7 inches of the subsoil is brown very cobbly clay loam. The lower 5 inches is brown extremely cobbly clay loam, which is underlain by basalt at a depth of about 15 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is moderately slow in the Laufer soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rockly soil is very shallow and well drained. It formed in material weathered from basalt and in some loess. Typically, the surface layer is brown extremely stony loam about 3 inches thick. The subsoil is about 6 inches of brown very cobbly loam, which is underlain by basalt at a depth of about 9 inches. The depth to basalt ranges from 4 to 10 inches.

Permeability is moderately slow in the Rockly soil. Available water capacity is very low. The effective rooting depth is 4 to 10 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as wildlife habitat or rangeland. The production of vegetation is limited by the very low available water capacity. The slope and the Rock outcrop limit access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and yarrow on the Laufer soil and Sandberg bluegrass and stiff sagebrush on the Rockly soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Sandberg bluegrass, decreases and the proportion of the less preferred plants, such as milkvetch, lupine, cheatgrass, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Range seeding generally is not practical because of the slope, the stones in the surface layer, and the Rock outcrop.

The Laufer and Rockly soils are in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

50-Laufer-Thiessen complex, 30 to 70 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 1,200 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

This unit is about 40 percent Laufer very stony clay loam and 35 percent Thiessen very stony silt loam. The Laufer soil is in convex areas, and the Thiessen soil is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Matheny very stony silt loam, Limekiln very stony silt loam, Thiessen Variant very stony silt loam, Rockly extremely stony loam, Laufer soils that have slopes of more than 70 percent, and Rock outcrop. Also included are areas of Bridgewater extremely stony sandy loam on flood plains and alluvial fans. The included areas make up about 25 percent of the unit.

The Laufer soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the surface layer is brown very stony clay loam about 3 inches thick. The upper 7 inches of the subsoil is brown very cobbly clay loam. The lower 5 inches is brown extremely cobbly clay loam, which is underlain by basalt at a depth of about 15 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is moderately slow in the Laufer soil. Available water capacity is *very* low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Thiessen soil is moderately deep and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the surface layer is brown very stony silt loam about 3 inches thick. The upper 14 inches of the subsoil is brown *very* cobbly clay loam. The lower 5 inches is brown extremely cobbly clay loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is moderately slow in the Thiessen soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low or very low available water capacity and the hazard of water erosion. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and balsamroot. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass, Idaho fescue, and balsamroot, decreases and the proportion of the less preferred plants, such as cheatgrass and other annual bromes, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding is not practical because of the slope and the stones in the surface layer. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The stones and cobbles in the soil profile, the shallowness to bedrock, and the slope interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIs, nonirrigated.

51-Laufer-Thiessen-Rock outcrop complex, 40 to 90 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 1,200 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

This unit is about 35 percent Laufer very stony clay loam, 30 percent Thiessen very stony silt loam, and 15 percent Rock outcrop. The Laufer soil is in convex areas, and the Thiessen soil and Rock outcrop are in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Matheny very stony silt loam, Limekiln very stony silt loam, Thiessen Variant very stony silt loam, Rockly extremely stony loam, and Laufer soils that have slopes of less than 40 percent or more than 90 percent. The included areas make up about 20 percent of the unit.

The Laufer soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the surface layer is brown very stony clay loam about 3 inches thick. The upper 7 inches of the subsoil is brown very cobbly clay loam. The lower 5 inches is brown extremely cobbly clay loam, which is underlain by basalt at a depth of about 15 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is moderately slow in the Laufer soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Thiessen soil is moderately deep and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the surface layer is brown very stony silt loam about 3 inches thick. The upper 14 inches of the subsoil is brown very cobbly clay loam. The lower 5 inches is brown extremely cobbly clay loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is moderately slow in the Thiessen soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low or very low available water capacity and the hazard of water erosion. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and balsamroot. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding is not practical because of the slope, the stones in the surface layer, the Rock outcrop, and the low or very low available water capacity. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The slope, the stoniness, the shallowness of the Laufer soil, and the Rock outcrop interfere with the installation of fences and watering facilities.

The Laufer and Thiessen soils are in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

52-Lawyer complex, 30 to 70 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly shrubs and grasses. Elevation is 1,400 to 3,200 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 110 to 135 days.

This unit is about 40 percent Lawyer stony silt loam and 35 percent Lawyer silt loam. Lawyer stony silt loam is on foot slopes, and Lawyer silt loam is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Mallory stony silt loam, Gwinly very stony silt loam, Rock outcrop, and Lawyer soils that have slopes of less than 30 percent or more than 70 percent. Also included are areas of Bridgewater extremely stony sandy loam on flood plains and alluvial fans. Also included are some areas where the depth to basalt is more than 60 inches. The included areas make up about 25 percent of the unit.

Lawyer stony silt loam is deep and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is very dark grayish brown stony silt loam. The lower 7 inches is very dark grayish brown gravelly silt loam. The upper 24 inches of the subsoil is dark grayish brown and brown very gravelly clay loam and brown very cobbly clay loam. The lower 9 inches is brown very cobbly clay, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to Winches.

Permeability is slow in Lawyer stony silt loam. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very high.

Lawyer silt loam is very deep and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the upper 22 inches of the surface layer is very dark grayish brown silt loam. The lower 5 inches is dark grayish brown gravelly loam. The subsoil to a depth of 60 inches or more is brown very gravelly clay loam.

Permeability is moderate in Lawyer silt loam. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit has few limitations in areas used as rangeland or wildlife habitat. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is Idaho fescue and bluebunch wheatgrass on Lawyer stony silt loam and Idaho fescue, bluebunch wheatgrass, and common snowberry on Lawyer silt loam. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue and bluebunch wheatgrass, decreases and the proportion of the less preferred plants, such as cheatgrass and other annual bromes, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Mechanical seeding generally is not practical because of the stones on Lawyer stony silt loam and the slope. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The stones interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIe, nonirrigated.

53-Lawyer-Gwinly complex, 40 to 90 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly shrubs and grasses. Elevation is 1,400 to 3,200 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 110 to 135 days.

This unit is about 30 percent Lawyer stony silt loam, 25 percent Lawyer silt loam, and 25 percent Gwinly very stony silt loam. Lawyer stony silt loam is on foot slopes, Lawyer silt loam is in concave areas, and the Gwinly soil is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Mallory stony silt loam, Rock outcrop, and Lawyer soils that have slopes of less than 40 percent or more than 90 percent. Also included are areas of Bridgewater extremely stony sandy loam on flood plains and alluvial fans and some areas where the depth to basalt is more than 60 inches. The included areas make up about 20 percent of the unit.

Lawyer stony silt loam is deep and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is very dark grayish brown stony silt loam. The lower 7 inches is very dark grayish brown gravelly silt loam. The upper 24 inches of the subsoil is dark grayish brown and brown very gravelly clay loam and brown very cobbly clay loam. The lower 9 inches is brown very cobbly clay, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is slow in Lawyer stony silt loam. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

Lawyer silt loam is very deep and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the upper 22 inches of the surface layer is very dark grayish brown silt loam. The lower 5 inches is dark grayish brown gravelly loam. The subsoil to a depth of 60 inches or more is brown *very* gravelly clay loam .

Permeability is slow in Lawyer silt loam. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very severe.

The Gwinly soil is shallow and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the surface layer is very dark gray very stony silt loam about 3 inches thick. The upper 7 inches of the subsoil is very dark gray very cobbly clay loam. The lower 8 inches is dark brown extremely cobbly clay, which is underlain by basalt at a depth of about 18 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Gwinly soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low available water capacity in the Gwinly soil. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is Idaho fescue and bluebunch wheatgrass on Lawyer stony silt loam and on the Gwinly soil and Idaho fescue, big bluegrass, and common snowberry on Lawyer silt loam. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue and bluebunch wheatgrass, decreases and the proportion of the less preferred plants, such as cheatgrass and other annual bromes, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Mechanical seeding generally is not practical because of the surface stoniness, the slope, and the very low available water capacity in the Gwinly soil. Areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The stones and the slope interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIe, nonirrigated.

54-Lawyer-Mallory complex, 30 to 90 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly shrubs and grasses. Elevation is 1,400 to 3,200 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 110 to 135 days.

This unit is about 40 percent Lawyer silt loam and 35 percent Mallory stony silt loam. The Lawyer soil is in concave areas, and the Mallory soil is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Lawyer stony silt loam, convex areas of Gwinly very stony silt loam, areas of Rock outcrop, and areas of Lawyer soils that have slopes of less than 30 percent or more than 90 percent. Also included are areas of Bridgewater extremely stony sandy loam on flood plains and alluvial fans and areas where the depth to basalt is more than 60 inches. The included areas make up about 25 percent of the unit.

The Lawyer soil is very deep and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the upper 22 inches of the surface layer is very dark grayish brown silt loam. The lower 5 inches is dark grayish brown cobbly loam. The upper 19 inches of the subsoil is brown very cobbly clay loam. The lower 4 inches is very pale brown very cobbly clay, which is underlain by basalt at a depth of about 50 inches. The depth to basalt ranges from 40 to 60 inches. The soil is calcareous below a depth of about 46 inches.

Permeability is slow in the Lawyer soil. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Mallory soil is moderately deep and well drained. It formed in loess, slope alluvium, and colluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is very dark grayish brown stony silt loam. The lower 8 inches is very dark grayish brown very cobbly clay loam. The subsoil is about 25 inches of dark brown very cobbly and extremely cobbly clay, which is underlain by basalt at a depth of about 37 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is slow in the Mallory soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low available water capacity in the Mallory soil. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is Idaho fescue and bluebunch wheatgrass on the Mallory soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue and bluebunch wheatgrass, decreases and the proportion of the less preferred plants, such as cheatgrass and other annual bromes, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Mechanical seeding generally is not practical because of the surface stoniness and low available water capacity of the Mallory soil and the slope of both soils. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The stones in the Mallory soil and the slope interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIe, nonirrigated.

55-Lickskillet-Rock outcrop complex, 60 to 120 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

This unit is about 45 percent Lickskillet very stony loam and 20 percent Rock outcrop. The Lickskillet soil is in slightly concave areas, and the Rock outcrop is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are convex areas of soils that are very shallow over basalt, Alpowa very stony silt loam on concave slopes, Schuelke very stony loam, and Lickskillet soils that have slopes of more than 120 percent. The included areas make up about 35 percent of the unit.

The Lickskillet soil is shallow and well drained. It formed in colluvium derived from loess and weathered basalt. Typically, the surface layer is dark grayish brown very stony loam about 4 inches thick. The subsoil is about 10 inches of dark grayish brown and light brownish gray very cobbly loam, which is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches. The soil is calcareous below a depth of about 7 inches.

Permeability is moderate in the Lickskillet soil. Available water capacity is *very* low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as wildlife habitat or rangeland. The production of vegetation is limited by the very low available water capacity and the shallowness to bedrock. The slope and the Rock outcrop severely limit access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass and Sandberg bluegrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Sandberg bluegrass, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, sixweeks fescue, and lomatium, increases.

Range seeding generally is not practical because of the slope, the Rock outcrop, droughtiness, and the stoniness. The stones, the shallowness to bedrock, the Rock outcrop, and the slope interfere with the installation of fences and watering facilities.

The Lickskillet soil is in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

56-Lickskillet-Schuelke very stony loams, 3 to 30 percent slopes. This map unit is on shoulder slopes. The native vegetation is mainly grasses. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

This unit is about 40 percent Lickskillet very stony loam and 35 percent Schuelke very stony loam. The Lickskillet soil is in convex areas, and the Schuelke soil is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Nims silt loam, soils that are very shallow over basalt, and Lickskillet soils that have slopes of more than 30 percent. The included areas make up about 25 percent of the unit.

The Lickskillet soil is shallow and well drained. It formed in colluvium derived from loess and weathered basalt. Typically, the surface layer is dark grayish brown very stony loam about 4 inches thick. The subsoil is about 10 inches of dark grayish brown and light brownish gray very cobbly loam, which is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches. The soil is calcareous below a depth of about 7 inches.

Permeability is moderate in the Lickskillet soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Schuelke soil is moderately deep and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark grayish brown very stony silt loam. The lower 5 inches is dark grayish brown very cobbly silt loam. The subsoil is about 13 inches of brown very cobbly and extremely cobbly clay loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches. The soil is calcareous below a depth of about 9 inches.

Permeability is moderate in the Schuelke soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low or very low available water capacity.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass on the Lickskillet soil and bluebunch wheatgrass, Idaho fescue, and lupine on the Schuelke soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass, decreases and the proportion of the less preferred forage plants, such as cheatgrass, other annual bromes, knapweed, yellow starthistle, and pricklypear, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning.

The main limitations affecting range seeding are the stones in the surface layer and the low or very low available water capacity. Broadcast seeding with aerial equipment or a hand seeder is the most effective method of seeding. The stones in the surface layer and subsoil and the shallowness to bedrock interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIs, nonirrigated.

57-Lickskillet-Schuelke very stony loams, 30 to 70 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

This unit is about 40 percent Lickskillet very stony loam and 35 percent Schuelke very stony loam. The Lickskillet soil is in convex areas, and the Schuelke soil is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Alpowa very stony silt loam, Rock outcrop, and Lickskillet soils that have slopes of more than 70 percent. Also included are areas of Bridgewater extremely stony loam on flood plains and alluvial fans. The included areas make up about 25 percent of the unit.

The Lickskillet soil is shallow and well drained. It formed in colluvium derived from loess and weathered basalt. Typically, the surface layer is dark grayish brown very stony loam about 4 inches thick. The subsoil is about 10 inches of dark grayish brown and light brownish gray cobbly loam, which is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches. The soil is calcareous below a depth of about 7 inches.

Permeability is moderate in the Lickskillet soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Schuelke soil is moderately deep and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark grayish brown very stony silt loam. The lower 5 inches is dark grayish brown very cobbly silt loam. The subsoil is about 13 inches of brown very cobbly and extremely cobbly clay, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches. The soil is calcareous below a depth of about 9 inches.

Permeability is moderate in the Schuelke soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low or low available water capacity. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass and Sandberg bluegrass on the Lickskillet soil and bluebunch wheatgrass, balsamroot, and Sandberg bluegrass on the Schuelke soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, knapweed, yellow starthistle, other annual bromes, and prickly lettuce, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The main limitation affecting livestock grazing is the slope. Mechanical seeding is not practical because of the stones in the surface layer, the slope, and the very low or low available water capacity. Steep areas that are burned or otherwise disturbed can be broadcast seeded with aerial equipment or a hand seeder. The stones and cobbles in the soil profile, the shallowness of the Lickskillet soil, and the slope interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIs, nonirrigated.

58-Lickskillet-Schuelke-Rock outcrop complex, 40 to 90 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

This unit is about 35 percent Lickskillet very stony loam, 30 percent Schuelke very stony loam, and 15 percent Rock outcrop. The Lickskillet soil and the Rock outcrop are in convex areas, and the Schuelke soil is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Alpowa very stony silt loam, convex areas of soils that are very shallow over basalt, and areas of Lickskillet soils that have slopes of more than 90 percent. Also included are areas of Bridgewater extremely stony sandy loam on flood plains and alluvial fans. The included areas make up about 20 percent of the unit.

The Lickskillet soil is shallow and well drained. It formed in colluvium derived from loess and weathered basalt. Typically, the surface layer is dark grayish brown very stony loam about 4 inches thick. The subsoil is about 10 inches of dark grayish brown and light brownish gray very cobbly loam, which is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches. The soil is calcareous below a depth of about 7 inches.

Permeability is moderate in the Lickskillet soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Schuelke soil is moderately deep and well drained. !t formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark grayish brown very stony loam. The lower 5 inches is dark grayish brown very cobbly silt loam. The subsoil is about 13 inches of brown very cobbly clay loam and brown extremely cobbly loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches. The soil is calcareous below a depth of about 9 inches.

Permeability is moderate in the Schuelke soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low or very low available water capacity. The slope and the Rock outcrop limit access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass and Sandberg bluegrass on the Lickskillet soil and bluebunch wheatgrass, balsamroot, and Sandberg bluegrass on the Schuelke soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and prickly lettuce, increases. Moderately sloping areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding generally is not practical because of the stones in the surface layer, the Rock outcrop, the slope, and the very low or low available water capacity. Areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The stones in the soil profile, the shallowness of the Lickskillet soil, the Rock outcrop, and the slope interfere with the installation of fences and watering facilities.

The Lickskillet and Schuelke soils are in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

59-Limekiln-Rock outcrop complex, 40 to 120 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

This unit is about 60 percent Limekiln very stony silt loam and 20 percent Rock outcrop. The Limekiln soil is in slightly concave areas, and the Rock outcrop is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas where greenstone is at a depth of less than 10 inches or more than 20 inches and areas of Limekiln soils that have slopes of less than 40 percent. The included areas make up about 20 percent of the unit.

The Limekiln soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered greenstone. Typically, the upper 4 inches of the surface layer is brown *very* stony silt loam. The lower 4 inches is brown very cobbly silt loam. The upper 4 inches of the subsoil is brown very cobbly loam. The lower 4 inches is white extremely cobbly loam. Greenstone is at a depth of about 16 inches. The depth to greenstone ranges from 10 to 20 inches. The soil is calcareous below a depth of about 8 inches.

Permeability is moderate in the Limekiln soil.

Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is greenstone.

This unit is used as wildlife habitat or rangeland. The production of vegetation is limited by the very low available water capacity. The slope and the Rock outcrop limit access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, balsamroot, and Sandberg bluegrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass, Sandberg bluegrass, and lomatium, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding generally is not practical because of the slope, the stoniness, the droughtiness, and the Rock outcrop. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The slope, the stones in the soil profile, and the Rock outcrop interfere with the installation of fences and watering facilities.

The Limekiln soil is in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

60-Limekiln-Stember complex, 3 to 30 percent slopes. This map unit is on shoulder slopes. The native vegetation is mainly grasses. Elevation is 2,600 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 120 to 135 days.

This unit is about 50 percent Limekiln *very* stony silt loam and 25 percent Stember silt loam. The Limekiln soil is in convex areas, and the Stember soil is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Pataha silt loam, Limekiln stony silt loam, Limekiln soils that have a subsoil of very cobbly or extremely cobbly clay loam, and Limekiln soils that have slopes of more than 30 percent. The included areas make up about 25 percent of the unit.

The Limekiln soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark grayish brown very stony silt loam. The lower 4 inches is dark grayish brown very cobbly silt loam. The upper 4 inches of the subsoil is brown very cobbly loam. The lower 4 inches is brown extremely cobbly loam, which is underlain by basalt at a depth of about 16 inches. The depth to basalt ranges from 10 to 20 inches. The soil is calcareous below a depth of about 8 inches.

Permeability is moderate in the Limekiln soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Stember soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the upper 7 inches of the surface layer is dark grayish brown silt loam. The lower 4 inches is dark grayish brown gravelly silt loam. The upper 4 inches of the subsoil is brown very cobbly silt loam. The lower 9 inches is white very cobbly loam, which is underlain by basalt at a depth of about 24 inches. The depth to basalt ranges from 20 to 30 inches. The soil is calcareous throughout.

Permeability is moderate in the Stember soil. Available water capacity is low. The effective rooting depth is 20 to 30 inches. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low or low available water capacity.

The potential native vegetation is bluebunch wheatgrass, balsamroot, and snow eriogonum on the Limekiln soil and bluebunch wheatgrass and Idaho fescue on the Stember soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass, balsamroot, and lomatium, decreases and the proportion of the less preferred plants, such as downy brome, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by mechanical treatment, chemical treatment, controlled burning, or tillage and seeding.

The main limitations affecting range seeding are the stoniness of the surface and the very low or low available water capacity. Broadcast seeding with aerial equipment or a hand seeder is the most effective method of seeding. Some areas of the Stember soil can be reseeded with a rangeland drill. The stoniness and shallowness of the Limekiln soil interfere with the installation of fences and watering facilities.

The Limekiln soil is in capability subclass VIIs, nonirrigated. The Stember soil is in capability subclass IVe, nonirrigated.

61-Limekiln-Thiessen Variant very stony silt loams, 30 to 70 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 900 to 3,300 feet. The

average annual precipitation is 15 to 18 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 120 to 145 days.

This unit is about 40 percent Limekiln very stony silt loam and 35 percent Thiessen Variant very stony silt loam. The Limekiln soil is in convex areas, and the Thiessen Variant is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Laufer very stony clay loam, Thiessen very stony silt loam, Rock outcrop, and Limekiln soils that have a surface layer of very stony silt loam and slopes of more than 70 percent. Also included are soils that have a subsoil of very cobbly or extremely cobbly clay loam, areas of Bridgewater extremely stony sandy loam on flood plains and alluvial fans, and areas where the depth to basalt is more than 40 inches. The included areas make up about 25 percent of the unit.

The Limekiln soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark grayish brown very stony silt loam. The lower 4 inches is dark grayish brown very cobbly silt loam. The upper 4 inches of the subsoil is brown very cobbly loam. The lower 4 inches is brown extremely cobbly loam, which is underlain by basalt at a depth of about 16 inches. The depth to basalt ranges from 10 to 20 inches. The soil is calcareous below a depth of about 8 inches.

Permeability is moderate in the Limekiln soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Thiessen Variant is moderately deep and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark grayish brown very stony silt loam. The lower 4 inches is dark grayish brown very cobbly silt loam. The subsoil is about 21 inches of pale brown very cobbly loam and light gray extremely cobbly loam, which is underlain by basalt at a depth of about 29 inches. The depth to basalt ranges from 20 to 40 inches. The soil is calcareous below a depth of about 8 inches.

Permeability is moderate in the Thiessen Variant. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low or low available water capacity. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, balsamroot, and Sandberg bluegrass on the Limekiln soil and bluebunch wheatgrass, Idaho fescue, yarrow, and balsamroot on the Thiessen Variant. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass, Sandberg bluegrass, and balsamroot, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding is not practical because of the slope, the stones on the surface, and the very low or low available water capacity. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The slope, the shallowness of the Limekiln soil, and the stones in the soil profile interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIs, nonirrigated.

62-Limekiln-Thiessen Variant-Rock outcrop complex, 40 to 90 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

This unit is about 35 percent Limekiln very stony silt loam, 30 percent Thiessen Variant very stony silt loam, and 15 percent Rock outcrop. The Limekiln soil is in convex areas, and the Thiessen Variant is in concave areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Laufer very stony clay loam, Thiessen very stony silt loam, Rock outcrop, and Limekiln soils that have a surface layer of very stony silt loam and slopes of more than 90 percent. Also included are soils that have a subsoil of very cobbly or extremely cobbly clay loam and areas where the depth to basalt is more than 40 inches. The included areas make up about 20 percent of the unit.

The Limekiln soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark grayish brown very stony silt loam. The lower 4 inches is dark grayish brown very cobbly silt loam. The upper 4 inches of the subsoil is brown very cobbly loam. The lower 4 inches is brown extremely cobbly loam, which is underlain by basalt at a depth of about 16 inches. The depth to basalt ranges from 10 to 20 inches. The soil is calcareous below a depth of about 8 inches.

Permeability is moderate in the Limekiln soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Thiessen Variant is moderately deep and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark grayish brown very stony silt loam. The lower 4 inches is dark grayish brown very cobbly silt loam. The subsoil is about 21 inches of pale brown very cobbly loam and light gray extremely cobbly loam, which is underlain by basalt at a depth of about 29 inches. The depth to basalt ranges from 20 to 40 inches. The soil is calcareous below a depth of about 8 inches.

Permeability is moderate in the Thiessen Variant. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low or low available water capacity. The slope and the Rock outcrop limit access by livestock and thus can result in overgrazing of the less sloping areas. Proper management of livestock grazing is needed to prevent excessive erosion.

The potential native vegetation is bluebunch wheatgrass, balsamroot, and Sandberg bluegrass on the Limekiln soil and bluebunch wheatgrass, Idaho fescue, yarrow, and balsamroot on the Thiessen Variant. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass, Sandberg bluegrass, and lomatium, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding is not practical because of the slope, the stones on the surface, the Rock outcrop, and the very low or low available water capacity. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The slope, the stones in the soil profile, and the Rock outcrop interfere with the installation of fences and watering facilities.

The Limekiln and Thiessen Variant soils are in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

63-Limekiln Variant very gravelly loam, 30 to 70 percent slopes. This shallow, well drained soil is on south-facing canyon walls. It formed in loess and colluvium derived from weathered limestone, shale, slate, and marine sandstone. The native vegetation is mainly grasses. Elevation is 1,000 to 2,800 feet. The average annual precipitation is 16 or 17 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

Typically, the surface layer is grayish brown very gravelly loam about 4 inches thick. The upper 6 inches of the subsoil is light brownish gray very gravelly loam. The lower 5 inches is white very gravelly loam. Weathered shale is at a depth of about 15 inches. The depth to weathered shale, limestone, slate, or marine sandstone ranges from 10 to 20 inches. The soil is calcareous throughout.

Permeability is moderate. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

Included in this unit are soils that have weathered shale, limestone, slate, or marine sandstone at a depth of less than 10 inches or more than 20 inches, Rock outcrop, and Limekiln Variant soils that have slopes of less than 30 percent or more than 70 percent. The included areas make up about 25 percent of the unit.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low available water capacity. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, eriogonum, and balsamroot. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Sandberg bluegrass, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and wild lettuce, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding is not practical because of the slope. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The slope interferes with the installation of fences and watering facilities.

This unit is in capability subclass VIIe, nonirrigated.

64-Mallory-Rock outcrop complex, 40 to 90 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly shrubs and grasses. Elevation is 1,400 to 3,200 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 110 to 135 days.

This unit is about 60 percent Mallory very stony silt loam and 15 percent Rock outcrop. The Mallory soil is in concave areas, and the Rock outcrop is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are convex areas of Gwinly very stony silt loam. Also included are Lawyer stony silt loam on foot slopes and in concave areas and Mallory soils that have slopes of more than 90 percent. The included areas make up about 25 percent of the unit.

The Mallory soil is moderately deep and well drained. It formed in loess, slope alluvium, and colluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is very dark grayish brown very stony silt loam. The lower 8 inches is very dark grayish brown very cobbly clay loam. The subsoil is about 25 inches of dark brown very cobbly and extremely cobbly clay, which is underlain by basalt at a depth of about 37 inches. The depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is stony silt loam.

Permeability is slow in the Mallory soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low available water capacity. The slope and the Rock outcrop limit access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is Idaho fescue and bluebunch wheatgrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The steep north-facing slopes are hazardous to livestock when the soil is frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soil remains saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Range seeding is not practical because of the stoniness, the Rock outcrop, the slope, and the low available water capacity. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The stones, the moderate depth to bedrock, the Rock outcrop, and the slope interfere with the installation of fences and watering facilities.

The Mallory soil is in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

65-Matheny silt loam, 10 to 30 percent slopes. This very deep, well drained soil is on foot slopes and on slump blocks on canyon walls. It formed in colluvium, slope alluvium derived from weathered basalt, and loess that has some volcanic ash. The native vegetation is mainly grasses. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 145 days.

Typically, the upper 8 inches of the surface layer is very dark grayish brown silt loam. The lower 6 inches is dark grayish brown silt loam. The upper 8 inches of the subsoil is dark grayish brown very cobbly clay loam. The lower part to a depth of 60 inches or more is brown extremely cobbly loam. The soil is calcareous below a depth of about 22 inches. In some areas the surface layer is stony silt loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Linville silt loam and Matheny soils that have slopes of less than 10 percent or more than 30 percent. The included areas make up about 25 percent of the unit.

This unit is used as rangeland or wildlife habitat. Few limitations affect the production of vegetation. The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and balsamroot. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass, prairie junegrass, and Idaho fescue, decreases and the proportion of the less preferred plants, such as yarrow, lupine, cheatgrass, and snowberry, increases. Areas that have an excessive number of undesirable shrubs can be improved by mechanical treatment, chemical treatment, or prescribed burning.

This unit is suited to range seeding by a single- or double-disk drill, a deep-furrow drill, or a rangeland drill. Undesirable plants can be controlled by fallowing prior to seeding or by applying chemicals.

This unit is in capability subclass IVe, nonirrigated.

66-Matheny stony silt loam, 10 to 30 percent slopes. This very deep, well drained soil is on foot slopes and on slump blocks on canyon walls. It formed in colluvium, slope alluvium derived from weathered basalt, and some volcanic ash. The native vegetation is mainly grasses. Elevation is 900 to 3,300 feet. The

average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 145 days.

Typically, the upper 4 inches of the surface layer is dark grayish brown stony silt loam. The lower 10 inches is dark grayish brown cobbly silt loam. The upper 8 inches of the subsoil is dark grayish brown very cobbly clay loam. The lower part to a depth of 60 inches or more is brown extremely cobbly loam. The soil is calcareous below a depth of about 22 inches. In some areas the surface layer is silt loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium or rapid, and the hazard of water erosion is moderate or severe.

Included in this unit are areas of Linville silt loam and Matheny soils that have slopes of less than 10 percent or more than 30 percent. The included areas make up about 25 percent of the unit.

This unit has few limitations in areas used as rangeland or wildlife habitat. The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and balsam root. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, goatweed, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by mechanical treatment, chemical treatment, controlled burning, or tillage and seeding.

This unit can be seeded with a rangeland drill and, in the more stony areas, with a double-disk drill or a deep-furrow drill. The main limitation affecting range seeding is the stoniness of the surface layer. The stones interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIe, nonirrigated.

67-Matheny-Linville silt loams, 30 to 90 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly shrubs and grasses. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 145 days.

This unit is about 45 percent Matheny silt loam and 30 percent Linville silt loam. The Matheny soil is on foot slopes, and the Linville soil is in concave areas and on foot slopes. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Matheny stony silt loam, Laufer very stony clay loam. Thiessen very stony silt loam, Rock outcrop, and Matheny soils that have slopes of less than 30 percent or more than 90 percent. Also included are areas of Bridgewater extremely stony sandy loam on flood plains and alluvial fans. The included areas make up about 25 percent of the unit.

The Matheny soil is deep and well drained. It formed in colluvium, slope alluvium derived from weathered basalt, and loess that has some volcanic ash. Typically, the upper 8 inches of the surface layer is very dark grayish brown silt loam. The lower 6 inches is dark grayish brown silt loam. The upper 8 inches of the subsoil is dark grayish brown very cobbly clay loam. The lower 22 inches is brown extremely cobbly loam, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to 60 inches. The soil is calcareous below a depth of about 22 inches.

Permeability is moderate in the Matheny soil. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Linville soil is very deep and well drained. It formed in slope alluvium, colluvium derived from basalt, and loess that has a minor amount of volcanic ash. Typically, the upper 18 inches of the surface layer is very dark grayish brown silt loam. The lower 7 inches is dark grayish brown cobbly silt loam. The upper 26 inches of the subsoil is dark grayish brown cobbly silt loam. The lower part to a depth of 60 inches or more is dark grayish brown and brown very cobbly loam.

Permeability is moderate in the Linville soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit has few limitations in areas used as rangeland or wildlife habitat. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas. Grazing should be delayed in the spring until the soils are dry and firm enough to withstand trampling by livestock.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and balsamroot on the Matheny soil and Idaho fescue and bluebunch wheatgrass on the Linville soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, annual forbs, and rose, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered.

Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Mechanical seeding generally is not practical because of the slope. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The slope interferes with the installation of fences and watering facilities.

This unit is in capability subclass VIIe, nonirrigated.

68-Matheny-Linville-Laufer complex, 40 to 90 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly shrubs and grasses. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 145 days.

This unit is about 30 percent Matheny silt loam, 25 percent Linville silt loam, and 25 percent Laufer very stony clay loam. The Matheny soil is on foot slopes, the Linville soil is in concave areas and on foot slopes, and the Laufer soil is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Matheny stony silt loam, Thiessen very stony silt loam, Rock outcrop, and Matheny soils that have slopes of less than 40 percent or more than 90 percent. Also included are areas of Bridgewater extremely stony sandy loam on flood plains and alluvial fans. The included areas make up about 20 percent of the unit.

The Matheny soil is deep and well drained. It formed in colluvium, slope alluvium derived from weathered basalt, and loess that has some volcanic ash. Typically, the upper 8 inches of the surface layer is very dark grayish brown silt loam. The lower 6 inches is dark grayish brown silt loam. The upper 8 inches of the subsoil is dark grayish brown very cobbly clay loam. The lower 22 inches is brown extremely cobbly loam, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to 60 inches. The soil is calcareous below a depth of about 22 inches.

Permeability is moderate in the Matheny soil. Available water capacity is high. The effective rooting is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Linville soil is very deep and well drained. It formed in slope alluvium, colluvium derived from basalt, and loess that has a minor amount of volcanic ash. Typically, the upper 18 inches of the surface layer is very dark grayish brown silt loam. The lower 7 inches is dark grayish brown cobbly silt loam. The upper 7 inches of the subsoil is dark grayish brown cobbly silt loam. The lower part to a depth of 60 inches or more is dark grayish brown and brown very cobbly silt loam.

Permeability is moderate in the Linville soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very severe.

The Laufer soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the surface layer is very dark grayish brown very stony clay loam about 3 inches thick. The upper 7 inches of the subsoil is dark grayish brown very cobbly clay loam. The lower 5 inches is dark grayish brown extremely cobbly clay loam, which is underlain by basalt at a depth of about 15 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is moderately slow in the Laufer soil. Available water capacity is very low. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low available water capacity in the Laufer soil. Proper management of livestock grazing is needed to prevent excessive erosion.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and balsamroot on the Matheny and Laufer soils and Idaho fescue and bluebunch wheatgrass on the Linville soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass, -Idaho fescue, and balsamroot. decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and rose, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Mechanical seeding generally is not practical because of the slope and the surface stoniness and very low available water capacity of the Laufer soil. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The slope, the shallowness to bedrock, and the stones in the surface layer of the Laufer soil interfere with the installation of fences and watering facilities.

The Matheny and Linville soils are in capability subclass VIIe, nonirrigated. The Laufer soil is in capability subclass VIIs, nonirrigated.

69-Matheny Variant-Limekiln Variant complex, 60 to 90 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly grasses. Elevation is 1,000 to 2,800 feet. The average annual precipitation is 16 or 17 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 135 days.

This unit is about 55 percent Matheny Variant silt loam and 25 percent Limekiln Variant very gravelly loam. The Matheny Variant is in concave areas, and the Limekiln Variant is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of soils that have weathered shale, limestone, slate, or marine sandstone at a depth of 20 to 40 inches or more than 60 inches. Also included are Matheny Variant soils that have slopes of less than 60 percent or more than 90 percent. The included areas make up about 20 percent of the unit.

The Matheny Variant is deep and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered marble, shale, slate, and marine sandstone. Typically, the surface layer is very dark grayish brown and dark grayish brown silt loam about 13 inches thick. The upper 5 inches of the subsoil is grayish brown loam. The next 19 inches is pale brown gravelly loam. The lower 6 inches is pale brown very gravelly loam, which is underlain by weathered shale at a depth of about 43 inches. The depth to weathered shale limestone, slate, or marine sandstone ranges from 40 to 60 inches. The soil is calcareous throughout.

Permeability is moderate in the Matheny Variant. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Limekiln Variant is shallow and well drained. It formed in loess and colluvium derived from weathered marble, shale, slate, and marine sandstone. Typically, the surface layer is dark grayish brown very gravelly loam about 4 inches thick. The upper 6 inches of the subsoil is light brownish gray very gravelly loam. The lower 5 inches is white very gravelly loam, which is underlain by weathered shale at a depth of about 15 inches. The depth to weathered shale limestone, slate, or marine sandstone ranges from 10 to 20 inches. The soil is calcareous throughout.

Permeability is moderate in the Limekiln Variant. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low available water capacity in the Limekiln Variant. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas. Proper management of livestock grazing is needed to prevent excessive erosion. Grazing should be delayed in the spring until the soil is dry and firm enough to withstand trampling by livestock.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and balsamroot on the Matheny Variant and bluebunch wheatgrass and Idaho fescue on the Limekiln Variant. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Range seeding generally is not practical because of the slope and the very low available water capacity of the Limekiln Variant. The slope and the shallowness of the Limekiln Variant interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIe, nonirrigated.

70-Nansene silt loam, 30 to 40 percent slopes. This very deep, well drained soil is on north-facing hillslopes and canyon walls. It formed in loess. The native vegetation is mainly grasses. Elevation is 1,000 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 160 days.

Typically, the upper 17 inches of the surface layer is dark grayish brown silt loam. The next 27 inches, which includes the lower part of the surface layer and the upper part of the subsoil, is brown silt loam. The lower part of the subsoil to a depth of 60 inches or more is pale brown silt loam. The soil is calcareous below a depth of about 44 inches.

Permeability is moderate. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

Included in this unit are areas of Asotin silt loam, Olical silt loam, and Nansene soils that have slopes of less than 30 percent or more than 40 percent. Also included are some areas where the depth to basalt is 40 to 60 inches. The included areas make up about 25 percent of the unit.

This unit is used as hayland and pasture or as rangeland. The main limitation in the areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seeding.

This unit has few limitations in the areas used as rangeland. The potential native vegetation is Idaho fescue and bluebunch wheatgrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue and bluebunch wheatgrass, decreases and the proportion of the less preferred plants, such as downy brome, prickly lettuce, and other annual bromes, increases. Areas that have an excessive number of undesirable shrubs can be improved by mechanical treatment, chemical treatment, controlled burning, or tillage and reseeding. Grazing should be delayed in the spring until the soil is dry and firm enough to withstand trampling by livestock.

The steep north-facing slopes are hazardous to livestock when the soil is frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soil remains saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

This unit is suited to range seeding by a single- or double-disk drill, a deep-furrow drill, or a rangeland drill. Undesirable plants can be controlled by summer fallowing prior to seeding or by applying chemicals. The main limitations affecting seeding are the slope and the hazard of water erosion.

This unit is in capability subclass VIe, nonirrigated.

71-Nansene silt loam, 40 to 60 percent slopes. This very deep, well drained soil is on north-facing hillslopes and canyon walls. It formed in loess. The native vegetation is mainly grasses. Elevation is 1,000 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 160 days.

Typically, the upper 17 inches of the surface layer is dark grayish brown silt loam. The next 27 inches, which includes the lower part of the surface layer and the upper part of the subsoil, is brown silt loam. The lower part of the subsoil to a depth of 60 inches or more is pale brown silt loam. The soil is calcareous below a depth of about 44 inches.

Permeability is moderate. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very severe.

Included in this unit are areas of Asotin silt loam, Bolicker silt loam, areas of soils that have a surface layer of stony silt loam, and Nansene soils that have slopes of less than 40 percent or more than 60 percent. Also included are some areas where the depth to basalt is 40 to 60 inches. The included areas make up about 25 percent of the unit.

This unit is used as rangeland or wildlife habitat. It has few limitations in the areas used as rangeland. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is Idaho fescue and bluebunch wheatgrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue and bluebunch wheatgrass, decreases and the proportion of the less preferred plants, such as downy brome, Japanese brome, yarrow, and mustard, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The steep north-facing slopes are hazardous to livestock when the soil is frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soil remains saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Mechanical seeding generally is not practical because of the slope. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The slope interferes with the installation of fences and watering facilities.

This unit is in capability subclass VIIe, nonirrigated.

72-Neconda silt loam, 3 to 6 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 3,000 to 3,300 feet. The average annual precipitation is 17 or 18 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 120 to 130 days.

Typically, the surface layer is dark grayish brown silt loam about 12 inches thick. The upper 9 inches of the subsoil is brown silty clay loam. The next 4 inches is pale brown gravelly clay. The lower 5 inches is light gray very cobbly loam, which is underlain by basalt at a depth of about 30 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 21 inches. In some areas the surface layer is silty clay loam.

Permeability is slow. Available water capacity is moderate. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Ferdinand silt loam, Geoconda silty clay loam, areas where a seasonal high water table is perched above the subsoil, areas of soils that have a surface layer of stony silty clay loam, and Neconda soils that have slopes of more than 6 percent. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland. The main hazard is water erosion. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain results in the efficient use of soil moisture and allows storage of more winter precipitation the following year. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IIIe, nonirrigated.

73-Neconda silty clay loam, 3 to 6 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 3,200 to 3,600 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 120 days.

Typically, the surface layer is very dark grayish brown and grayish brown silty clay loam about 12 inches thick. The upper 15 inches of the subsoil is brown silty clay loam. The next 7 inches is brown gravelly clay. The lower 3 inches is very pale brown very cobbly loam, which is underlain by basalt at a depth of about 37 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 34 inches. In some areas the surface layer is silt loam.

Permeability is slow. Available water capacity is moderate. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Ferdinand silty clay loam, Geoconda silty clay loam, areas of soils that have a surface layer of stony silty clay loam and a seasonal high water table that is perched above the subsoil, and Neconda soils that have slopes of more than 6 percent. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland. The main crops are wheat, barley, and oats and grass for seed. The main hazard is water erosion. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. The amount of crop residue produced by spring crops is low. As a result, careful management is needed to control water erosion. An adequate cover of crop residue at seeding time and a rough, cloddy surface layer during winter reduce the hazard of water erosion. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake.

Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IIIe, nonirrigated.

74-Neconda silty clay loam, 8 to 15 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 3,200 to 3,600 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 120 days.

Typically, the surface layer is very dark grayish brown and grayish brown silty clay loam about 12 inches thick. The upper 15 inches of the subsoil is brown silty clay loam. The next 7 inches is brown gravelly clay. The lower 3 inches is very pale brown very cobbly silt loam, which is underlain by basalt at a depth of about 37 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 34 inches. In some areas the surface layer is silt loam.

Permeability is slow. Available water capacity is moderate. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Ferdinand silty clay loam, Geoconda silty clay loam, areas of soils that have a surface layer of stony silty clay loam, areas where a seasonal high water table is perched above the subsoil, and Neconda soils that have slopes of less than 8 percent or more than 15 percent. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland. The main crops are wheat, barley, and oats and grass for seed. The main hazard is water erosion. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. The amount of crop residue produced by spring crops is low. As a result, careful management is needed to control water erosion. An adequate cover of crop residue at seeding time and a rough, cloddy surface layer during winter reduces the hazard of water erosion. Chiseling stubble fields across the slope when the soil is dry in the fall shatters restrictive layers and increases the rate of water intake.

Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IIIe, nonirrigated.

75-Neissenberg-Pataha silt loams, 3 to 8 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 2,600 to 3,400 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 135 days.

This unit is about 50 percent Neissenberg silt loam and 25 percent Pataha silt loam. The Neissenberg soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size, and the Pataha soil is in areas between the slick spots. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Stember silt loam, areas where basalt is at a depth of more than 40 inches, and Neissenberg soils that have slopes of more than 8 percent. The included areas make up about 25 percent of the unit.

The Neissenberg soil is moderately deep and moderately well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 10 inches of the subsoil is brown silty clay that has a high content of sodium. The next 6 inches is brown silty clay loam. The lower 10 inches is light gray very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 17 inches.

Permeability is slow in the Neissenberg soil. Available water capacity is moderate. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Pataha soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the upper 13 inches of the surface layer is dark grayish brown silt loam. The lower 4 inches is grayish brown silt loam. The upper 8 inches of the subsoil is grayish brown gravelly silt loam. The lower 8 inches is light gray very cobbly and very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 13 inches.

Permeability is moderate in the Pataha soil. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion and the high content of sodium in the subsoil of the Neissenberg soil. A 3-year rotation of winter wheat, spring barley, and fallow is suitable. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. The amount of crop residue produced by spring crops is low. As a result, careful management is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching. Growing annual grain reduces the hazard of water erosion, results in the efficient use of soil moisture, and increases the rate of water intake.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter help to control erosion. Stubble mulching leaves an adequate amount of crop residue on the surface and thus helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred.

Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IIIe, nonirrigated.

76-Nims silt loam, 3 to 8 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 7 inches of the subsoil is brown gravelly silt loam. The lower 9 inches is white very cobbly loam, which is underlain by basalt at a depth of about 23 inches. The depth to basalt ranges from 20 to 30 inches. The soil is calcareous below a depth of about 14 inches.

Permeability is moderate. Available water capacity is low. The effective rooting depth is 20 to 30 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Weissenfels silt loam, areas of soils that have a surface layer of cobbly silt loam, and areas where basalt is within a depth of 20 inches. Also included are areas of Olical silt loam, areas of Nims soils that have slopes of more than 8 percent, and areas where the depth to basalt is 30 to 40 inches. The included areas make up about 25 percent of the unit.

This unit is used mainly as nonirrigated cropland. It also is used for hay and pasture. The main limitations affecting nonirrigated cropland are the hazard of water erosion, the low available water capacity, the low annual precipitation, and the cobbles on or near the surface. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, barley, and fallow is needed. Fallowing is necessary if the amount of winter precipitation is exceptionally low.

The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage is restricted in areas where stones and cobbles are on or near the surface.

Terraces reduce the length of slopes. They help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

The amount of forage on hayland and pasture is reduced because of the low available water capacity.

This unit is in capability subclass IVe, nonirrigated.

77-Nims silt loam, 8 to 15 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 7 inches of the subsoil is brown gravelly silt loam. The lower 9 inches is white very cobbly loam, which is underlain by basalt at a depth of about 23 inches. The depth to basalt ranges from 20 to 30 inches. The soil is calcareous below a depth of about 14 inches.

Permeability is moderate. Available water capacity is low. The effective rooting depth is 20 to 30 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Weissenfels silt loam, areas of soils that have a surface layer of cobbly silt loam, areas where basalt is within a depth of 20 inches, areas of Olical silt loam, and areas of Nims soils that have slopes of less than 8 percent or more than 15 percent. Also included are some areas where the depth to basalt is 30 to 40 inches. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland, hayland, or pasture. The main limitations affecting nonirrigated cropland are the hazard of water erosion, the low available water capacity, the low annual precipitation, and the stones and cobbles near the surface. Because precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, barley, and fallow is needed. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control water erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry in the fall shatters restrictive layers and increases the rate of water intake. Tillage is restricted in areas where cobbles are on or near the surface.

Terraces can reduce the length of slopes. If seeded to grass, they help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

The amount of forage on hayland and pasture is reduced because of the low available water capacity. This unit is in capability subclass IVe, nonirrigated.

78-Nims silt loam, 15 to 30 percent slopes. This moderately deep, well drained soil is on hillslopes. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 7 inches of the subsoil is brown gravelly silt loam. The lower 9 inches is white very cobbly loam, which is underlain by basalt at a depth of about 23 inches. The depth to basalt ranges from 20 to 30 inches. The soil is calcareous below a depth of about 14 inches.

Permeability is moderate. Available water capacity is low. The effective rooting depth is 20 to 30 inches. Runoff is rapid, and the hazard of water erosion is severe.

Included in this unit are areas of Weissenfels silt loam, areas of soils that have a surface layer of cobbly silt loam, areas where basalt is within a depth of 20 inches, areas of Olical silt loam, and areas of Nims soils that have slopes of less than 15 percent or more than 30 percent. Also included are some areas where the depth to basalt is 30 to 40 inches. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland, hayland, or pasture. The main limitations affecting nonirrigated cropland are the hazard of water erosion, the low available water capacity, the low annual precipitation, and the cobbles on or near the surface. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, barley, and fallow is needed. Growing grasses or grasses and legumes in the rotation about 50 percent of the time helps to control water erosion and maintain tilth. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control water erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry in the fall shatters restrictive layers and increases the rate of water intake. Tillage is restricted in areas where stones and cobbles are on or near the surface. Dividing the field slopes into two or more cropping patterns helps to control water erosion on part of the slopes.

The main limitations in the areas used for hay and pasture are the hazard of water erosion during seedling establishment and the low available water capacity. Seeding forage crops on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seeding. The amount of forage on hayland and pasture is reduced because of the low available water capacity.

This unit is in capability subclass IVe, nonirrigated.

79-Nims-Weissenfels silt loams, 3 to 8 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

This unit is about 50 percent Nims silt loam and 30 percent Weissenfels silt loam. The Nims soil is in areas between slick spots, and the Weissenfels soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Olical silt loam, Spofford silt loam, and Nims soils that have slopes of more than 8 percent. Also included are some areas where the depth to basalt is 20 to 30 inches. The included areas make up about 20 percent of the unit.

The Nims soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 15 inches thick. The upper 11 inches of the subsoil is brown silt loam. The lower 9 inches is white very cobbly and very gravelly loam, which is underlain by basalt at a depth of about 35 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 19 inches.

Permeability is moderate in the Nims soil. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Weissenfels soil is moderately deep and moderately well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 8 inches of the subsoil is grayish brown silty clay and brown silty clay loam that has a high content of sodium. The next 7 inches is brown silt loam. The lower 15 inches is very pale brown and white very gravelly loam, which is underlain by basalt at a depth of about 37 inches. The depth to basalt ranges from 25 to 40 inches. The soil is calcareous below a depth of about 15 inches.

Permeability is slow in the Weissenfels soil. Available water capacity is moderate. The effective rooting depth is 25 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion, the low annual precipitation, and the high content of sodium in the subsoil of the Weissenfels soil. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, barley, and fallow is needed. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control water erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry in the fall shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred.

Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IIIe, nonirrigated.

80-Nims-Weissenfels silt loams, 8 to 15 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

This unit is about 40 percent Nims silt loam and 35 percent Weissenfels silt loam. The Nims soil is in areas between slick spots, and the Weissenfels soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Olical silt loam, Spofford silt loam, and Nims soils that have slopes of less than 8 percent. Also included are some areas where the depth to basalt is 15 to 25 inches. The included areas make up about 25 percent of the unit.

The Nims soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 15 inches thick. The upper 11 inches of the subsoil is brown silt loam. The lower 9 inches is white very cobbly and very gravelly loam, which is underlain by basalt at a depth of about 35 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 19 inches.

Permeability is moderate in the Nims soil. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Weissenfels soil is moderately deep and moderately well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 8 inches of the subsoil is grayish brown silty clay and brown silty clay loam that has a high content of sodium. The next 7 inches is brown silt loam. The lower 15 inches is very pale brown and white very gravelly loam, which is underlain by basalt at a depth of about 37 inches. The depth to basalt ranges from 25 to 40 inches. The soil is calcareous below a depth of about 15 inches.

Permeability is slow in the Weissenfels soil. Available water capacity is moderate. The effective rooting depth is 25 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion, the low annual precipitation, and the high content of sodium in the subsoil of the Weissenfels soil. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, barley, and fallow is needed. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control water erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred.

Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

The Nims soil is in capability subclass IIIe, nonirrigated. The Weissenfels soil is in capability subclass IVe, nonirrigated.

81-Nims-Weissenfels silt loams, 15 to 30 percent slopes. This map unit is on hillslopes. The native vegetation is mainly grasses. Elevation is 1.200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

This unit is about 40 percent Nims silt loam and 35 percent Weissenfels silt loam. The Nims soil is in areas between slick spots, and the Weissenfels soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Olical silt loam, Spofford silt loam, and Nims soils that have slopes of less than 15 percent. The included areas make up about 25 percent of the unit.

The Nims soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 15 inches thick. The upper 11 inches of the subsoil is brown silt loam. The lower 9 inches is white very cobbly and very gravelly loam, which is underlain by basalt at a depth of about 35 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 19 inches.

Permeability is moderate in the Nims soil. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Weissenfels soil is moderately deep and moderately well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 8 inches of the subsoil is grayish brown silty clay and brown silty clay loam that has a high content of sodium. The next 7 inches is brown silt loam. The lower 15 inches is very pale brown and white *very* gravelly loam, which is underlain by basalt at a depth of about 37 inches. The depth to basalt ranges from 25 to 40 inches. The soil is calcareous below a depth of about 15 inches.

Permeability is slow in the Weissenfels soil. Available water capacity is moderate. The effective rooting depth is 25 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as nonirrigated cropland, hayland, or pasture. The main limitations affecting nonirrigated cropland are the hazard of water erosion, the low annual precipitation, and the high content of sodium in the subsoil of the Weissenfels soil. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, barley, and fallow about 50 percent of the time is needed. Growing grasses or grasses and legumes in the rotation about 50 percent of the time helps to control water erosion and maintain tilth. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred. Dividing field slopes into two or more cropping patterns helps to control water erosion on part of the slopes.

The main limitation in the areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seeding.

This unit is in capability subclass IVe, nonirrigated.

82-Olical-Spofford silt loams, 3 to 8 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

This unit is about 45 percent Olical silt loam and 30 percent Spofford silt loam. The Olical soil is in areas between slick spots, and the Spofford soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Nims silt loam, Weissenfels silt loam, and Olical soils that have slopes of more than 8 percent. Also included are some areas where the depth to basalt is 40 to 60 inches. The included areas make up about 25 percent of the unit.

The Olical soil is very deep and well drained. It formed in loess. Typically, the upper 7 inches of the surface layer is dark grayish brown silt loam. The lower 3 inches is brown silt loam. The upper 7 inches of the subsoil also is brown silt loam. The lower part to a depth of 60 inches or more is pale brown silt loam. The soil is calcareous below a depth of about 17 inches.

Permeability is moderate in the Olical soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

The Spofford soil is very deep and moderately well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam about 10 inches thick. The upper 13 inches of the subsoil is brown silty clay loam and pale brown silt loam that has a high content of sodium. The lower part to a depth of 60 inches or more is light gray silt loam. The soil is calcareous below a depth of about 23 inches.

Permeability is slow in the Spofford soil. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion, the low annual precipitation, and the high content of sodium in the subsoil of the Spofford soil. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, barley, and fallow is needed. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control water erosion after fall seeding in a wheat-fallow rotation. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred. Terraces reduce the length of slopes. They help to prevent excessive runoff, concentrated flow, and rill erosion. Stripcropping can help to control water erosion on long slopes.

The Olical soil is in capability subclass IIe, nonirrigated. The Spofford soil is in capability subclass IIIe, nonirrigated.

83-Olical-Spofford silt loams, 8 to 15 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

This unit is about 45 percent Olical silt loam and 30 percent Spofford silt loam. The Olical soil is in areas between slick spots, and the Spofford soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Nims silt loam, Weissenfels silt loam, and Olical soils that have slopes of less than 8 percent or more than 15 percent. Also included are some areas where the depth to basalt is 40 to 60 inches. The included areas make up about 25 percent of the unit.

The Olical soil is very deep and well drained. It formed in loess. Typically, the upper 7 inches of the surface layer is dark grayish brown silt loam. The lower

3 inches is brown silt loam. The upper 7 inches of the subsoil also is brown silt loam. The lower part to a depth of 60 inches or more is pale brown silt loam. The soil is calcareous below a depth of about 17 inches.

Permeability is moderate in the Olical soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

The Spofford soil is very deep and moderately well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam about 10 inches thick. The upper 13 inches of the subsoil is brown silty clay loam and pale brown silt loam that has a high content of sodium. The lower part to a depth of 60 inches or more is light gray silt loam. The soil is calcareous below a depth of about 23 inches.

Permeability is slow in the Spofford soil. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion, the low annual precipitation, and the high content of sodium in the subsoil of the Spofford soil. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, barley, and fallow is needed. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred. Terraces can reduce the length of slopes. If seeded to grass, they help to prevent excessive runoff, concentrated flow, and rill erosion. Stripcropping helps to control water erosion on long slopes.

The Olical soil is in capability subclass IIIe, nonirrigated. The Spofford soil is in capability subclass IVe, nonirrigated.

84-Olical-Spofford silt loams, 15 to 30 percent slopes. This map unit is on hillslopes. The native vegetation is mainly grasses. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

This unit is about 45 percent Olical silt loam and 30 percent Spofford silt loam. The Olical soil is in areas between slick spots, and the Spofford soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Nims silt loam, Weissenfels silt loam, and Olical soils that have slopes of less than 15 percent or more than 30 percent. Also included are some areas where the depth to basalt is 40 to 60 inches. The included areas make up about 25 percent of the unit.

The Olical soil is very deep and well drained. It formed in loess. Typically, the upper 7 inches of the surface layer is dark grayish brown silt loam. The lower 3 inches is brown silt loam. The upper 7 inches of the subsoil also is brown silt loam. The lower part to a depth of 60 inches or more is pale brown silt loam. The soil is calcareous below a depth of about 17 inches.

Permeability is moderate in the Olical soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

The Spofford soil is very deep and moderately well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam about 10 inches thick. The upper 13 inches of the subsoil is brown silty clay loam and pale brown silt loam that has a high content of sodium. The lower part to a depth of 60 inches or more is light gray silt loam. The soil is calcareous below a depth of about 23 inches.

Permeability is slow in the Spofford soil. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion, the low annual precipitation, and the high content of sodium in the subsoil of the Spofford soil. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, barley, and fallow about 50 percent of the time is needed. Growing grasses or grasses and legumes in the rotation about 50 percent of the time helps to control water erosion and maintain tilth. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching reduces the hazard of water erosion after fall seeding in a wheat-fallow rotation. Chiseling or subsoiling stubble fields across the slope when the soil is dry in the fall shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred. Dividing the field slopes into two or more cropping patterns helps to control water erosion on part of the slopes.

This unit is in capability subclass IVe, nonirrigated.

85-Olot silt loam, 3 to 30 percent slopes. This moderately deep, well drained soil is on north-facing mountain plateaus and mountainsides. It formed in a mantle of volcanic ash over loess and material weathered from basalt. The native vegetation is mainly conifers. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface is covered with a mat of partially decomposed needles and twigs about 2 inches thick. The surface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is about 13 inches of pale brown silt loam. The next 22 inches is a buried subsoil of brown very cobbly silt loam and dark brown extremely cobbly silty clay loam, which is underlain by basalt at a depth of about 37 inches. The depth to basalt ranges from 20 to 40 inches. In some areas the mantle of volcanic ash is 20 to 26 inches thick.

Permeability is moderately slow. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Tolo silt loam, Sweiting silt loam, Harlow very stony silt loam, and Olot soils that have slopes of more than 30 percent. Also included are small areas of soils that are similar to the Olot soil but have a cooler temperature and are at elevations above 4,800 feet. The included areas make up about 25 percent of the unit.

This unit is used as grazeable woodland or wildlife habitat. Grand fir and Douglas fir are the principal tree species. The trees of limited extent include western larch, ponderosa pine, and Engelmann spruce. The habitat type is generally grand fir-pachistima. On the basis of a 50-year site curve, the mean site index is 75 for grand fir and 61 for Douglas fir. The highest average growth rate in unmanaged, even-aged stands is 104 cubic feet per acre per year for grand fir at age 110. In a typical basal area, however, the composition of grand fir is reduced by about 95 percent and growth rates are reduced accordingly. The highest average growth rate in unmanaged, even-aged stands is 46 cubic feet per acre per year for Douglas fir at age 109.

The main limitations affecting timber harvesting are occasional snowpack and the muddiness caused by seasonal wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced logging roads are soft when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit. On unsurfaced logging roads, measures that abate dustiness during dry periods are needed to reduce road surface degradation and improve visibility.

Equipment and logs on the surface when the soil is wet or moist can result in a high degree of compaction and puddling. Steep yarding paths, skid trails, and firebreaks are subject to rifling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, and erosion. A moderate reduction in soil productivity can result from unmanaged fires in undisturbed areas.

Seedling establishment is the main concern affecting the production of timber. Reforestation can be accomplished by planting Douglas fir or ponderosa pine seedlings. If seed trees are available, natural reforestation by grand fir, Douglas fir, ponderosa pine, and western larch occurs readily in cutover areas. Seedlings that are planted or naturally established in the less fertile subsoil grow poorly and lack vigor. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means. Because the rooting depth is restricted by the underlying bedrock, trees are occasionally subject to windthrow when the soil is wet and winds are strong.

The forest understory vegetation is snowberry, pachystima, dwarf huckleberry, and strawberry. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as fescue, blue wifdrye, strawberry, and rose, decreases and the proportion of the less preferred forage plants, such as snowberry, ceanothus, and pinegrass, increases. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder.

This unit is in capability subclass VIe, nonirrigated.

86-Pataha-Neissenberg silt loams, 3 to 8 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 2,600 to 3,400 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 135 days.

This unit is about 45 percent Pataha silt loam and 30 percent Neissenberg silt loam. The Pataha soil is in areas between slick spots, and the Neissenberg soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Stember silt loam, Catheen silt loam, Spofmore silt loam, and Pataha soils that have slopes of more than 8 percent. The included areas make up about 25 percent of the unit.

The Pataha soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the upper 13 inches of the surface layer is dark grayish brown silt loam. The lower 4 inches is grayish brown silt loam. The upper 8 inches of the subsoil is grayish brown gravelly silt loam. The lower 8 inches is light gray very cobbly and very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 13 inches.

Permeability is moderate in the Pataha soil. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Neissenberg soil is moderately deep and moderately well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 10 inches of the subsoil is brown silty clay that has a high content of sodium. The next 6 inches is brown silty clay loam. The lower 10 inches is light gray very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 17 inches.

Permeability is slow in the Neissenberg soil. Available water capacity is moderate. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion and the high content of sodium in the subsoil of the Neissenberg soil. A 3-year rotation of winter wheat, spring barley, and fallow is needed. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

An adequate cover of crop residue at seeding time and a rough, cloddy surface layer during winter reduce the hazard of water erosion. Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred.

Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IIIe, nonirrigated.

87-Pataha-Neissenberg silt loams, 8 to 15 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 2,600 to 3,400 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 135 days.

This unit is about 45 percent Pataha silt loam and 30 percent Neissenberg silt loam. The Pataha soil is in areas between slick spots, and the Neissenberg soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Stember silt loam, Catheen silt loam, Spofmore silt loam, and Pataha soils that have slopes of less than 8 percent or more than 15 percent. The included areas make up about 25 percent of the unit.

The Pataha soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the upper 13 inches of the surface layer is dark grayish brown silt loam. The lower

4 inches is grayish brown silt loam. The upper 8 inches of the subsoil is grayish brown gravelly silt loam. The lower 8 inches is light gray very cobbly and very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 13 inches.

Permeability is moderate in the Pataha soil. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Neissenberg soil is moderately deep and moderately well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 10 inches of the subsoil is brown silty clay that has a high content of sodium. The next 6 inches is brown silty clay loam. The lower 10 inches is light gray very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 17 inches.

Permeability is slow in the Neissenberg soil. Available water capacity is moderate. The effective rooting depth is 30 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion and the high content of sodium in the subsoil of the Neissenberg soil. A 3-year rotation of winter wheat, spring barley, and fallow is suitable. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter help to control water erosion. Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred.

Terraces can reduce the length of slopes. If seeded to grass, they help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

The Pataha soil is in capability subclass IIIe, nonirrigated. The Neissenberg soil is in capability subclass IVe, nonirrigated.

88-Peola-Neissenberg silt loams, 3 to 8 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

This unit is about 45 percent Peola silt loam and 30 percent Neissenberg silt loam. The Peola soil is in areas between slick spots, and the Neissenberg soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Alpowa Variant silt loam, Catheen silt loam, Spofmore silt loam, and Peola soils that have slopes of more than 8 percent. The included areas make up about 25 percent of the unit.

The Peola soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 14 inches thick. The upper 11 inches of the subsoil is brown silt loam. The lower 11 inches is white very cobbly loam, which is underlain by basalt at a depth of about 36 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 25 inches.

Permeability is moderate in the Peola soil. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Neissenberg soil is moderately deep and moderately well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 10 inches of the subsoil is brown silty clay that has a high content of sodium. The next 6 inches is brown silty clay loam. The lower 10 inches is light gray very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 17 inches.

Permeability is slow in the Neissenberg soil. Available water capacity is moderate. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion and the high content of sodium in the subsoil of the Neissenberg soil. A 3-year rotation of winter wheat, spring barley, and fallow is suitable. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry in the fall shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred.

Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IIIe, nonirrigated.

89-Peola-Neissenberg silt loams, 8 to 15 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

This unit is about 45 percent Peola silt loam and 30 percent Neissenberg silt loam. The Peola soil is in areas between slick spots, and the Neissenberg soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Alpowa Variant silt loam, Catheen silt loam, Spofmore silt loam, and Peola soils that have slopes of less than 8 percent. The included areas make up about 25 percent of the unit.

The Peola soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 14 inches thick. The upper 11 inches of the subsoil is brown silt loam. The lower 11 inches is white very cobbly loam, which is underlain by basalt at a depth of about 36 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 25 inches.

Permeability is moderate in the Peola soil. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Neissenberg soil is moderately deep and moderately well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 10 inches of the subsoil is brown silty clay that has a high content of sodium. The next 6 inches is brown silty clay loam. The lower 10 inches is light gray very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 17 inches.

Permeability is slow in the Neissenberg soil. Available water capacity is moderate. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion and the high content of sodium in the subsoil of the Neissenberg soil. A 3-year rotation of winter wheat, spring barley, and fallow is suitable. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry in the fall shatters restrictive layers and increases the rate of water intake. Surface crusting can be minimized by chiseling instead of moldboard plowing, which mixes the upper part of the subsoil, which is high in content of sodium, with the surface layer. Terraces can reduce the length of slopes. If seeded to grass, they help to control runoff, gullying, and sheet and rill erosion. Stripcropping can help to control water erosion on long slopes.

The Peola soil is in capability subclass IIIe, nonirrigated. The Neissenberg soil is in capability subclass IVe, nonirrigated.

90-Peola-Neissenberg silt loams, 15 to 30 percent slopes. This map unit is on hillslopes. The native vegetation is mainly grasses. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

This unit is about 45 percent Peola silt loam and 30 percent Neissenberg silt loam. The Peola soil is in areas between slick spots, and the Neissenberg soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Alpowa Variant silt loam, Catheen silt loam, Spofmore silt loam, and Peola soils that have slopes of less than 15 percent or more than 30 percent. The included areas make up about 25 percent of the unit.

The Peola soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown and dark brown silt loam about 14 inches thick. The upper 11 inches of the subsoil is brown silt loam. The lower 7 inches is white very cobbly loam, which is underlain by basalt at a depth of about 36 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 25 inches.

Permeability is moderate in the Peola soil. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

The Neissenberg soil is moderately deep and moderately well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 10 inches of the subsoil is brown silty clay that has a high content of sodium. The next 6 inches is brown silty clay loam. The lower 10 inches is light gray very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 17 inches.

Permeability is slow in the Neissenberg soil. Available water capacity is moderate. The effective rooting depth is 30 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as nonirrigated cropland, hayland, or pasture. The main limitations affecting nonirrigated cropland are the hazard of water erosion and the high content of sodium in the subsoil of the Neissenberg soil. A suitable rotation is annual grain or a 3-year rotation of winter wheat, spring barley, and fallow about 50 percent of the time. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. Growing grasses or grasses and legumes in the rotation about 50 percent of the time helps to control water erosion and maintain tilth. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred.

The main limitation in the areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seedling establishment.

This unit is in capability subclass IVe, nonirrigated.

91-Peola-Neissenberg silt loams, 30 to 40 percent slopes. This map unit is on hillslopes. The native vegetation is mainly grasses. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

This unit is about 50 percent Peola silt loam and 25 percent Neissenberg silt loam. The Peola soil is in areas between slick spots, and the Neissenberg soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Alpowa Variant silt loam, Catheen silt loam, Spofmore silt loam, and Peola soils that have slopes of less than 30 percent or more than 40 percent. The included areas make up about 25 percent of the unit.

The Peola soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown and dark brown silt loam about 14 inches thick. The upper 11 inches of the subsoil is brown silt loam. The lower 11 inches is white very cobbly loam, which is underlain by basalt at a depth of about 32 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 25 inches.

Permeability is moderate in the Peola soil. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Neissenberg soil is moderately deep and moderately well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 10 inches of the subsoil is brown silty clay that has a high content of sodium. The next 6 inches is brown silty clay loam. The lower 10 inches is light gray very gravelly loam, which is underlain by basalt at a depth of about 33 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 17 inches.

Permeability is slow in the Neissenberg soil. Available water capacity is moderate. The effective rooting depth is 30 to 40 inches. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as rangeland or nonirrigated cropland. Few limitations affect the production of vegetation. The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by mechanical or chemical treatment or by prescribed burning. The unit is suited to range seeding with a single- or double-disk drill, a deep-furrow drill, or rangeland drill. Undesirable plants can be controlled by fallowing prior to seeding or by chemical treatment.

The main limitation affecting nonirrigated cropland is the hazard of water erosion and the high content of sodium in the subsoil of the Neissenberg soil.

This unit is in capability subclass VIe, nonirrigated.

92-Powwahkee silt loam, 3 to 6 percent slopes. This very deep, well drained soil is on plateaus. It formed in loess. The native vegetation is mainly grasses. Elevation is 3,200 to 3,600 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 120 days.

Typically, the surface layer is dark grayish brown silt loam about 22 inches thick. The upper 17 inches of the subsoil is brown silty clay loam. The next 16 inches is brown silty clay loam and brown and yellowish brown silty clay. The lower part to a depth of 60 inches or more is brown silty clay loam. The soil is calcareous below a depth of about 51 inches.

Permeability is moderately slow. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit are areas of Geoconda silty clay loam, Neconda silty clay loam, and Powwahkee soils that have slopes of more than 6 percent. Also included are some areas where the depth to basalt is 40 to 60 inches. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland. The main crops are wheat, barley, and oats and grass for seed. Few limitations affect nonirrigated cropland. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter increase the rate of water intake. Subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake.

This unit is in capability subclass IIe, nonirrigated.

93-Rockly very cobbly loam, 3 to 30 percent slopes. This very shallow, well drained soil is on ridgetops. It formed in material weathered from basalt and in some loess. The native vegetation is mainly grasses. Elevation is 3,000 to 3,600 feet. The average annual precipitation is 15 to 25 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 110 to 145 days.

Typically, the surface layer is brown very cobbly loam about 3 inches thick. The subsoil is about 6 inches of brown very cobbly loam and extremely cobbly clay loam, which is underlain by basalt at a depth of about 9 inches. The depth to basalt ranges from 4 to 10 inches.

Permeability is moderately slow. Available water capacity is very low. The effective rooting depth is 4 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Gwinly very stony silt loam, Mallory very stony silt loam, and Ferdinand silt loam. The included areas make up about 25 percent of the unit.

This unit is used as rangeland or wildlife habitat. The production of forage is limited by the very low available water capacity. The potential native vegetation is Sandberg bluegrass, stiff sagebrush, bluebunch wheatgrass, and Idaho fescue. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, annual bromes, yarrow, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Range seeding generally is not practical because of the very low available water capacity and the cobbles in the surface layer. The vegetation is damaged if the range is trampled by livestock when the soil is wet in the spring. The cobbles and the shallowness to bedrock interfere with the installation of fences and watering facilities.

This unit is in capability subclass VIIs, nonirrigated.

94-Snell silty clay loam, 3 to 8 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and colluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 3,400 to 4,100 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 90 to 115 days.

Typically, the upper 7 inches of the surface layer is very dark grayish brown silty clay loam. The lower 4 inches is very dark grayish brown gravelly silty clay loam. The upper 5 inches of the subsoil is dark grayish brown gravelly silty clay. The lower 7 inches is brown very gravelly silty clay, which is underlain by basalt at a depth of about 23 inches. The depth to basalt ranges from 20 to 30 inches. In some areas the surface layer is cobbly silty clay loam.

Permeability is moderately slow. Available water capacity is low. The effective rooting depth is 20 to 30 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Sweitberg silty clay loam, areas where the depth to basalt is less than 20 inches, and Snell soils that have slopes of more than 8 percent. The included areas make up about 25 percent of the unit.

This unit is used as hayland and pasture or as nonirrigated cropland. The main limitations in the areas used for hay and pasture are the low available water capacity and the short growing season. The amount of forage on hayland and pasture is reduced because of the low available water capacity.

The main limitations affecting nonirrigated cropland are the hazard of water erosion, the low available water capacity, the short growing season, wetness in the spring, and the stones and cobbles on or near the surface. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. The main crops are wheat, barley, and oats. The weather conditions may result in a late spring planting date. Spring barley or oats are better suited than spring wheat. An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage is restricted in areas where stones and cobbles are on or near the surface.

Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Field diversions can intercept excess runoff and thus minimize gullying in areas where steeper soils are upslope from this soil. Stubble mulching helps to control water erosion after fall seeding in a wheat-fallow rotation. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion.

This unit is in capability subclass IVe, nonirrigated.

95-Snell silty clay loam, 8 to 15 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and colluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 3,400 to 4,100 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 90 to 115 days.

Typically, the upper 7 inches of the surface layer is very dark grayish brown silty clay loam. The lower 4 inches is very dark grayish brown gravelly silty clay loam. The upper 5 inches of the subsoil is dark grayish brown gravelly silty clay. The lower 7 inches is brown very gravelly silty clay, which is underlain by basalt at a depth of about 23 inches. The depth to basalt ranges from 20 to 30 inches. In some areas the surface layer is cobbly silty clay loam.

Permeability is moderately slow. Available water capacity is low. The effective rooting depth is 20 to 30 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Sweitberg silty clay loam, areas where the depth to basalt is less than 20 inches, and Snell soils that have slopes of less than 8 percent or more than 15 percent. The included areas make up about 25 percent of the unit.

This unit is used as hayland and pasture or as nonirrigated cropland. The main limitations in the areas used for hay and pasture are the low available water capacity and the short growing season. The amount of forage on hayland and pasture is reduced because of the low available water capacity.

The main limitations affecting nonirrigated cropland are the hazard of water erosion, the low available water capacity, the short growing season, wetness in the spring, and the stones and cobbles on or near the surface. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. The main crops are wheat, barley, and oats. The weather conditions may result in a late spring planting date. Spring barley or oats are better suited than spring wheat.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. Tillage is restricted in areas where stones and cobbles are on or near the surface.

Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Field diversions can intercept excess runoff and thus minimize gullying in areas where steeper soils are upslope from this soil. Stripcropping can help to control water erosion on long slopes. This unit is in capability subclass IVe, nonirrigated.

96-Snell-Harlow-DeMasters complex, 60 to 90 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly shrubs and grasses. Elevation is 3,000 to 4,500 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 90 to 110 days.

This unit is about 35 percent Snell stony loam, 30 percent Harlow very stony clay loam, and 25 percent DeMasters silt loam. The Snell soil is in slightly concave areas, the Harlow soil is in convex areas, and the DeMasters soil is in concave areas and on foot slopes. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of soils that have a surface layer of stony silt loam, areas where the depth to basalt is more than 40 inches, Rock outcrop, and DeMasters soils that have slopes of less than 60 percent or more than 90 percent. Also included are some areas where the depth to basalt is more than 60 inches and areas of Bridgewater extremely stony sandy loam on alluvial fans and flood plains. The included areas make up about 15 percent of the unit.

The Snell soil is moderately deep and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the upper 6 inches of the surface layer is dark grayish brown very stony clay loam. The lower 6 inches is dark grayish brown very gravelly clay loam. The subsoil is about 13 inches of dark grayish brown very cobbly clay loam and brown extremely cobbly clay, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is very stony loam.

Permeability is moderately slow in the Snell soil. Available water capacity is low. Runoff is very rapid, and the hazard of water erosion is very severe.

The Harlow soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from basalt. Typically, the upper 3 inches of the surface layer is dark grayish brown very stony clay loam. The lower 3 inches is dark grayish brown very gravelly clay loam. The subsoil is 12 inches of dark grayish brown very cobbly clay loam and dark brown very cobbly clay, which is underlain by basalt at a depth of about 18 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Harlow soil. Available water capacity is very low. The effective rooting depth is

10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The DeMasters soil is deep and well drained. It formed in colluvium derived from weathered basalt and in loess that has some volcanic ash. Typically, the upper 9 inches of the surface layer is black silt loam. The lower 15 inches is very dark grayish brown silt loam. The upper 9 inches of the subsoil is dark brown cobbly loam. The lower 11 inches is brown cobbly loam, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderate in the DeMasters soil. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low or very low available water capacity in the Snell and Harlow soils and the short growing season. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas. Proper management of livestock grazing is needed to prevent excessive erosion. Grazing should be delayed in the spring until the soils are dry and firm enough to withstand trampling by livestock.

The potential native vegetation is Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass on the Snell soil; Idaho fescue, bluebunch wheatgrass, and prairie junegrass on the Harlow soil; and Idaho fescue, common snowberry, and bluebunch wheatgrass on the DeMasters soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as annual bromes, annual forbs, rose, and snowberry, increases. Areas that. have an excessive number of undesirable shrubs can be improved by chemical treatment.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Range seeding generally is not practical because of the slope and the surface stoniness and very low or low available water capacity of the Snell and Harlow soils. The stones, the shallowness of the Harlow soil, and the slope interfere with the installation of fences and watering facilities.

The Snell and Harlow soils are in capability subclass VIIs, nonirrigated. The DeMasters soil is in capability subclass VIIe, nonirrigated.

97-Snell-Harlow-Rock outcrop complex, 40 to 90 percent slopes. This map unit is on north-facing canyon walls. The native vegetation is mainly shrubs and grasses. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

This unit is about 35 percent Snell very stony loam, 30 percent Harlow very stony clay loam, and 15 percent Rock outcrop. The Snell soil is in smooth areas, and the Harlow soil and the Rock outcrop are in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of DeMasters silt loam, Harlow soils that have slopes of more than 90 percent, areas of soils that have a surface layer of very stony or stony loam, and areas where the depth to basalt is more than 40 inches. The included areas make up about 20 percent of the unit.

The Snell soil is moderately deep and well drained. It formed in loess and colluvium derived from weathered basalt. Typically, the upper 6 inches of the surface layer is dark grayish brown very stony loam. The lower 6 inches is dark grayish brown very gravelly clay loam. The subsoil is about 13 inches of dark grayish brown very cobbly clay loam and brown extremely cobbly clay, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is stony loam.

Permeability is moderately slow in the Snell soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is *very* severe.

The Harlow soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 3 inches of the surface layer is dark grayish brown very stony clay loam. The lower 3 inches is dark grayish brown very gravelly clay loam. The subsoil is about 12 inches of dark grayish brown very cobbly clay loam and dark brown very cobbly clay, which is underlain by basalt at a depth of about 18 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Harlow soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is basalt.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the low or very low available water capacity. The slope and the Rock outcrop limit access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass on the Snell soil and Idaho fescue, bluebunch wheatgrass, and prairie junegrass on the Harlow soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as cheatgrass, other annual bromes, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The steep north-facing slopes are hazardous to livestock when the soils are frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soils remain saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Mechanical seeding generally is not practical because of the stones in the surface layer, the slope, and the very low or low available water capacity. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The stoniness, the shallowness of the Harlow soil, the slope, and the Rock outcrop interfere with the installation of fences and watering facilities.

The Snell and Harlow soils are in capability subclass VIIs, nonirrigated. The Rock outcrop is in capability subclass VIIIs.

98-Spofmore-Catheen silt loams, 3 to 8 percent slopes. This map unit is on plateaus. The native vegetation is mainly grasses. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

This unit is about 50 percent Spofmore silt loam and 35 percent Catheen silt loam. The Spofmore soil occurs as scattered circular slick spots in depressions 4 to 6 feet in size, and the Catheen soil is in areas between the slick spots. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Pataha silt loam, Peola silt loam, Neissenberg silt loam, Stember silt loam, and Spofmore soils that have slopes of more than 10 percent. Also included are some areas where the depth to basalt is 40 to 60 inches. The included areas make up about 15 percent of the unit.

The Spofmore soil is very deep and moderately well drained. It formed in loess. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 11 inches of the subsoil is brown silty clay that has a high content of sodium. The next 6 inches is brown silty clay loam. The lower part to a depth of 60 inches or more is light gray and brown silt loam. The soil is calcareous below a depth of about 18 inches.

Permeability is slow in the Spofmore soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

The Catheen soil is very deep and well drained. It formed in loess. Typically, the surface layer is dark grayish brown silt loam about 13 inches thick. The upper 12 inches of the subsoil is brown silty clay loam. The lower part to a depth of 60 inches or more is pale brown and brown silty clay loam. The soil is calcareous below a depth of about 25 inches.

Permeability is moderate in the Catheen soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as nonirrigated cropland. The main limitations are the hazard of water erosion and the high content of sodium in the subsoil of the Spofmore soil. A 3-year rotation of winter wheat, spring barley, and fallow is suitable. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred. Terraces help to prevent excessive runoff, concentrated flow, and rill erosion. Stripcropping can help to control water erosion on long slopes.

The Spofmore soil is in capability subclass IIIe, nonirrigated. The Catheen soil is in capability subclass IIe, nonirrigated.

99-Stember silt loam, 3 to 8 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 2,600 to 3,400 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 135 days.

Typically, the upper 7 inches of the surface layer is dark grayish brown silt loam. The lower 4 inches is dark grayish brown gravelly silt loam. The upper 4 inches of the subsoil is brown very cobbly silt loam. The lower 9 inches is white very cobbly loam, which is underlain by basalt at a depth of about 24 inches. The depth to basalt ranges from 20 to 30 inches. The soil is calcareous throughout. In some areas the surface layer is cobbly silt loam.

Permeability is moderate. Available water capacity is low. The effective rooting depth is 20 to 30 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Pataha silt loam, areas of Neissenberg silt loam, areas where basalt is within a depth of 20 inches, and areas of Stember soils that have slopes of more than 8 percent. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland or as hayland and pasture. The main limitations affecting nonirrigated cropland are the hazard of water erosion, the low available water capacity, and the stones and cobbles on or near the surface. A 3-year rotation of winter wheat, spring barley, and fallow is suitable. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage is restricted in areas where stones and cobbles are on or near the surface.

Terraces reduce the length of slopes. They help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

The main limitation in the areas used for hay and pasture is the low available water capacity.

This unit is in capability subclass IVe, nonirrigated.

100-Sweitberg silty clay loam, 3 to 8 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 3,400 to 4,100 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 44 degrees F, and the average frost-free period is 90 to 115 days.

Typically, the surface layer is dark grayish brown silty clay loam about 9 inches thick. The upper 19 inches of the subsoil is dark grayish brown silty clay loam and brown silty clay. The lower 4 inches is brown very cobbly clay, which is underlain by basalt at a depth of about 32 inches. The depth to basalt ranges from 30 to 40 inches.

Permeability is slow. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Snell silty clay loam, Sweitberg stony silty clay loam, Sweitberg Variant silty clay loam, and Sweitberg soils that have slopes of more than 8 percent. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland, hayland, or pasture. The main limitations affecting nonirrigated cropland are the hazard of water erosion, wetness in the spring, and the short growing season. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed. The main crops are wheat, barley, and oats. The weather conditions may result in a late spring planting date. Spring barley and oats are better suited than spring wheat.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Terraces reduce the length of slopes. They help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Field diversions can intercept excess runoff and thus minimize gullying in areas where steeper soils are upslope from this soil. Stripcropping can help to control water erosion on long slopes.

The main limitation in the areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seedling establishment.

This unit is in capability subclass IIIe, nonirrigated.

101-Sweitberg silty clay loam, 8 to 15 percent slopes. This moderately deep, well drained soil is on plateaus. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 3,400 to 4,100 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 44 degrees F, and the average frost-free period is 90 to 115 days.

Typically, the surface layer is dark grayish brown silty clay loam about 9 inches thick. The upper 19 inches of the subsoil is dark grayish brown silty clay loam and brown silty clay. The lower 4 inches is brown very cobbly clay, which is underlain by basalt at a depth of about 32 inches. The depth to basalt ranges from 30 to 40 inches.

Permeability is slow. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Snell silty clay loam, Sweitberg stony silty clay loam, Sweitberg Variant silty clay loam, and Sweitberg soils that have slopes of less than 8 percent or more than 15 percent. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland, hayland, or pasture. The main limitations affecting nonirrigated cropland are the hazard of water erosion, the short growing season, and wetness in the spring. The soil profile usually is filled with moisture each year. Runoff and water erosion are accelerated when the soil is fallowed.

Annual cropping of small grain allows storage of more winter precipitation the following year. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The main crops are wheat, barley, and oats. Because of the short growing season, small grain does not grow well. Spring barley and oats are better suited than spring wheat because weather conditions result in a late spring planting date. An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake.

Terraces can reduce the length of slopes. If seeded to grass, they help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Field diversions intercept excess runoff and thus minimize gullying in areas where steeper soils are upslope from this soil. Stripcropping helps to control water erosion on long slopes.

The main limitation in the areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seedling establishment.

This unit is in capability subclass IIIe, nonirrigated.

102-Sweitberg Variant silty clay loam, 3 to 8 percent slopes. This deep, well drained soil is on plateaus. It formed in loess and in material weathered from basalt. The native vegetation is mainly grasses. Elevation is 3,400 to 4,300 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is about 44 degrees F, and the average frost-free period is 90 to 115 days.

Typically, the surface layer is very dark gray silty clay loam about 12 inches thick. The upper 28 inches of the subsoil is brown silty clay loam and brown silty clay. The lower 4 inches is brown very cobbly clay, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is slow. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Sweitberg silty clay loam, Snell silty clay loam, Sweitberg stony silty clay loam, and Sweitberg Variant soils that have slopes of more than 8 percent. Also included are some areas where basalt is at a depth of more than 60 inches. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland, hayland, or pasture. The main crops are wheat, barley, and oats. The main limitations affecting nonirrigated cropland are the short growing season and wetness in the spring. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The weather conditions may result in a late spring planting date. Spring barley or oats are better suited than spring wheat.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake.

Terraces reduce the length of slopes. They help to prevent excessive runoff, concentrated flow, and rill erosion. Field diversions can intercept excess runoff and thus minimize gullying in areas where steeper soils are upslope from this soil.

The main limitation in the areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seedling establishment.

This unit is in capability subclass IIIe, nonirrigated.

103-Sweitberg Variant silty clay loam, 8 to 15 percent slopes. This deep, well drained soil is on plateaus. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly grasses. Elevation is 3,400 to 4,100 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 44 degrees F, and the average frost-free period is 90 to 115 days.

Typically, the surface layer is very dark gray silty clay loam about 12 inches thick. The upper 28 inches of the subsoil is brown silty clay loam and brown silty clay. The lower 4 inches is brown very cobbly clay, which is underlain by basalt at a depth of about 44 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is slow. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Sweitberg silty clay loam, Snell silty clay loam, Sweitberg Variant stony silty clay loam, and Sweitberg Variant soils that have slopes of less than 8 percent or more than 15 percent. Also included are some areas where the depth to basalt is more than 60 inches. The included areas make up about 25 percent of the unit.

This unit is used as nonirrigated cropland, hayland, or pasture. The main crops are wheat, barley, and oats. The main limitations affecting nonirrigated cropland are the hazard of water erosion, the short growing season, and wetness in the spring. Growing annual grain helps to control water erosion, results in the efficient use of soil moisture, and increases the rate of water intake. The weather conditions may result in a late spring planting date. Spring barley and oats are better suited than spring wheat. An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Chiseling or subsoiling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake.

Terraces can reduce the length of slopes. If seeded to grass, they help to prevent excessive runoff, concentrated flow, and rill erosion. Field diversions can intercept excess runoff and thus minimize gullying in areas where steeper soils are upslope from this soil. Stripcropping can help to control water erosion on long slopes.

The main limitation in the areas used for hay and pasture is the hazard of water erosion during seedling establishment. Seeding forage crops on the contour or across the slope can help to control rill erosion. Keeping crop residue on the surface helps to control runoff and erosion. It also aids in maintaining a suitable environment for seeding.

This unit is in capability subclass IIIe, nonirrigated.

104-Sweiting silt loam, 3 to 30 percent slopes. This moderately deep, well drained soil is on mountain plateaus and benches. It formed in loess and slope alluvium derived from weathered basalt. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface is covered with a mat of partly decomposed needles and twigs about 2 inches thick. The surface layer is dark grayish brown silt loam about 9 inches thick. The upper 9 inches of the subsoil is brown silty clay loam. The lower 4 inches is brown very cobbly silty clay loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is slow. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Cloverland silt loam, Harlow very stony clay loam, and Sweiting soils that have slopes of more than 30 percent. The included areas make up about 25 percent of the unit.

This unit is used as grazeable woodland, hayland, pasture, nonirrigated cropland, or wildlife habitat. Ponderosa pine is the principal tree species. Douglas fir is of limited extent. The habitat type is generally ponderosa pine-snowberry. On the basis of a 100-year site curve, the mean site index is 83 for ponderosa pine. The highest average growth rate in unmanaged, even-aged stands is 74 cubic feet per acre per year for ponderosa pine at age 40. In a typical basal area, however, the composition of ponderosa pine is about 60 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting are occasional snowpack and the muddiness caused by seasonal wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced logging roads are soft, sticky, and slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit.

Equipment and logs on the surface when the soil is wet or moist can result in a high degree of compaction and puddling. Steep skid trails and firebreaks are subject to rilling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, and erosion.

Seedling establishment is the main concern affecting the production of timber. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are available, natural reforestation by ponderosa pine occurs readily in cutover areas. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means. Because the rooting depth is restricted by the underlying bedrock, trees are occasionally subject to windthrow when the soil is wet and winds are strong.

The forest understory vegetation is pinegrass, common snowberry, Idaho fescue, and bluebunch wheatgrass. If the woodland is overgrazed, the proportion of the preferred forage plants, such as, bluebunch wheatgrass and Idaho fescue, decreases and the proportion of the less preferred plants, such as annual bromes, annual bluegrasses, and snowberry, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

The density of the overstory generally is the main factor that limits the kind and amount of vegetation. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. Undesirable plants can be controlled by chemical treatment prior to seeding.

The main limitation in the areas used for hay and pasture is the short growing season. Seeding on the contour or across the slope where practical helps to prevent the formation of erosion patterns during periods when hay or pasture plants are becoming established. Grazing when the soil is wet results in compaction of the surface layer and excessive runoff.

The main limitations affecting nonirrigated cropland are the hazard of water erosion, wetness in the spring, and the short growing season. The main crops are wheat, barley, and oats and grass for seed. Growing grasses or grasses and legumes in the rotation about 50 percent of the time and annual grain about 50 percent of the time helps to control water erosion and maintain tilth. The weather conditions may result in a late spring planting date. Spring barley and oats are better suited than spring wheat.

An adequate cover of crop residue at seeding time and a rough, cloddy surface during winter reduce the hazard of water erosion. Field diversions can intercept excess runoff and thus minimize gullying in areas where steeper soils are upslope from this soil. Dividing field slopes into two or more cropping patterns helps to control erosion on part of the slopes.

This unit is in capability subclass IVe, nonirrigated.

105-Sweiting-Harlow complex, 3 to 30 percent slopes. This map unit is on mountain plateaus and benches. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

This unit is about 50 percent Sweiting silt loam and 25 percent Harlow very stony clay loam. The Sweiting soil is on mounds and in concave areas, and the Harlow soil is between the mounds and in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Cloverland silt loam, Snell very stony clay loam, and Sweiting soils that have slopes of more than 30 percent. Included areas make up about 25 percent of the unit.

The Sweiting soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface is covered with a mat of partially decomposed needles and twigs about 2 inches thick. The surface layer is dark grayish brown silt loam about 9 inches thick. The upper 9 inches of the subsoil is brown silty clay loam. The lower 4 inches is brown very cobbly silty clay loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is slow in the Sweiting soil. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Harlow soil is shallow and well drained. It formed in loess, colluvium, and slope alluvium derived from weathered basalt. Typically, the upper 3 inches of the surface layer is dark grayish brown very stony clay loam. The lower 3 inches is dark grayish brown very gravelly clay loam. The subsoil is about 8 inches of brown very cobbly clay loam and brown extremely cobbly clay, which is underlain by basalt at a depth of about 14 inches. The depth to basalt ranges from 10 to 20 inches.

Permeability is slow in the Harlow soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as grazeable woodland or wildlife habitat. Ponderosa pine is the principal tree species on the Sweiting soil. Douglas fir is of limited extent. The habitat type is generally ponderosa pine-snowberry. On the basis of a 100-year site curve, the mean site index is 83 for ponderosa pine on the Sweiting soil. The highest average growth rate in unmanaged, even-aged stands is 74 cubic feet per acre per year for ponderosa pine at age 40. In a typical basal area, however, the composition of ponderosa pine is reduced by about 60 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting on the Sweiting soil are occasional snowpack and the muddiness caused by seasonal wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced logging roads are soft, sticky, and slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit.

Equipment and logs on the surface when the Sweiting soil is wet or moist can result in a high degree of compaction and puddling. Steep skid trails and firebreaks are subject to rilling and gullying unless protected by- adequate water bars or a plant cover. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, and erosion.

Seedling establishment is the main concern affecting the production of timber on the Sweiting soil. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are available, natural reforestation by ponderosa pine occurs readily in cutover areas. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means. Because the rooting depth is restricted by the underlying bedrock, trees are occasionally subject to windthrow when the soil is wet and winds are strong.

This unit is suited to livestock grazing and browsing. The forest understory vegetation on the Sweiting soil is pinegrass, common snowberry, Idaho fescue, and bluebunch wheatgrass. The potential native vegetation on the Harlow soil is bluebunch wheatgrass, Idaho fescue, and balsamroot. If the woodland is overgrazed, the proportion of the preferred forage plants, such as mountain brome, bluebunch wheatgrass, and Idaho fescue, decreases and the proportion of the less preferred forage plants, such as annual bromes, annual bluegrasses, and snowberry, increases. The density of the overstory generally is the main factor that limits the kind and amount of forage. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

Mechanical seeding generally is not practical because of the stones in the surface layer and the very low available water capacity in the Harlow soil. Areas that are logged, burned, or otherwise disturbed can be seeded aerially, with a hand seeder, or with a rangeland drill. Undesirable plants can be controlled by chemical treatment. The stoniness and shallowness of the Harlow soil interfere with the installation of fences and watering facilities.

The Sweiting soil is in capability subclass IVe, nonirrigated. The Harlow soil is in capability subclass VIIs, nonirrigated.

106-Sweiting-Harlow Variant complex, 3 to 30 percent slopes. This map unit is on mountain plateaus and benches. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

This unit is about 40 percent Sweiting silt loam and 35 percent Harlow Variant very stony loam. The Sweiting soil is on mounds and in concave areas, and the Harlow Variant is between the mounds and in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Harlow very stony clay loam, Cloverland silt loam, and Sweiting soils that have slopes of more than 30 percent. The included areas make up about 25 percent of the unit.

The Sweiting soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface is covered with a mat of partially decomposed needles and twigs about 2 inches thick. The surface layer is dark grayish brown silt loam about 9 inches thick. The upper 9 inches of the subsoil is brown silty clay loam. The lower 4 inches is brown very cobbly silty clay loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is slow in the Sweiting soil. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Harlow Variant is very shallow and well drained.

It formed in loess and slope alluvium derived from weathered basalt. Typically, the upper 2 inches of the surface layer is dark grayish brown very stony loam. The lower 3 inches is dark brown very gravelly loam. The subsoil is about 4 inches of dark brown extremely cobbly clay loam, which is underlain by basalt at a depth of about 9 inches. The depth to basalt ranges from 4 to 10 inches. In some areas the surface layer is very cobbly loam.

Permeability is slow in the Harlow Variant. Available water capacity is very low. The effective rooting depth is 5 to 10 inches. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as grazeable woodland or wildlife habitat. Ponderosa pine is the principal tree species on the Sweiting soil. Douglas fir is of limited extent. The habitat type is generally ponderosa pine-snowberry. On the basis of a 100-year site curve, the mean site index is 83 for ponderosa pine on the Sweiting soil. The highest average growth rate in unmanaged, even-aged stands is 74 cubic feet per acre per year for ponderosa pine at age 40. In a typical basal area, however, the composition of ponderosa pine is reduced by about 60 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting on the Sweiting soil are occasional snowpack and the muddiness caused by seasonal wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced logging roads are soft, sticky, and slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit.

Equipment and logs on the surface when the Sweiting soil is wet or moist can result in a high degree of compaction and puddling. Steep skid trails and firebreaks are subject to rifling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, and erosion.

Seedling establishment is the main concern affecting the production of timber on the Sweiting soil. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are available, natural reforestation by ponderosa pine occurs readily in cutover areas. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means. Because the rooting depth is restricted by the underlying bedrock, trees are occasionally subject to windthrow when the soil is wet and winds are strong.

The forest understory vegetation on the Sweiting soil is pinegrass, common snowberry, Idaho fescue, and bluebunch wheatgrass. The potential native vegetation on the Harlow Variant is Sandberg bluegrass, Douglas eriogonum, bottlebrush squirreltail, and balsamroot. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as mountain brome, prairie junegrass, Idaho fescue, and strawberry, decreases and the proportion of the less preferred forage plants, such as annual bromes, Kentucky bluegrass, lupine, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning. The density of the overstory is the main factor that limits the kind and amount of vegetation.

Mechanical seeding generally is not practical because of the surface stoniness and very low available water capacity in the Harlow Variant. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. Undesirable plants can be controlled by chemical treatment. The stones and depth to bedrock in the Harlow Variant interfere with the installation of fences and watering facilities.

The Sweiting soil is in capability subclass IVe, nonirrigated. The Harlow Variant is in capability subclass VIIs, nonirrigated.

107-Sweiting-Klicker complex, 3 to 30 percent slopes. This map unit is on mountain plateaus and benches. The native vegetation is mainly conifers, shrubs, and grasses. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

This unit is about 40 percent Sweiting silt loam and 35 percent Klicker very stony silt loam. The Sweiting soil is in concave, smooth areas, and the Klicker soil is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are concave areas of Cloverland silt loam, areas of Harlow very stony clay loam, and areas of Klicker soils that have slopes of more than 30 percent. The included areas make up about 25 percent of the unit.

The Sweiting soil is moderately deep and well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface is covered with a mat of partially decomposed needles and twigs about 2 inches thick. The surface layer is dark grayish brown silt loam about 9 inches thick. The upper 9 inches of the subsoil is brown silty clay loam. The lower 4 inches is brown very cobbly silty clay loam, which is underlain by basalt at a depth of about 22 inches. The depth to basalt ranges from 20 to 40 inches.

Permeability is slow in the Sweiting soil. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Klicker soil is moderately deep and well drained. It formed in loess, slope alluvium, and colluvium derived from weathered basalt. Typically, the upper 4 inches of the surface layer is dark brown very stony silt loam. The lower 7 inches is dark brown very cobbly silt loam. The subsoil is about 14 inches of dark brown extremely cobbly clay loam, which is underlain by basalt at a depth of about 25 inches. The depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is stony silt loam.

Permeability is moderately slow in the Klicker soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as grazeable woodland or wildlife habitat. Ponderosa pine is the principal tree species on the Sweiting soil. Douglas fir is of limited extent. The habitat type is generally ponderosa pine-snowberry. On the basis of a 100-year site curve, the mean site index is 83 for ponderosa pine on the Sweiting soil. The highest average growth rate in unmanaged, even-aged stands is 74 cubic feet per acre per year for ponderosa pine at age 40. In a typical basal area, however, the composition of ponderosa pine is reduced by about 60 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting are occasional snowpack and the muddiness caused by seasonal wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced logging roads are soft, sticky, and slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit.

Equipment and logs on the surface when the Sweiting soil is wet or moist can result in a high degree of compaction and puddling. Skid trails and firebreaks are subject to rilling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, and erosion.

Seedling establishment is the main concern affecting the production of timber on the Sweiting soil. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are available, natural reforestation by ponderosa pine occurs readily in cutover areas. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means. Because the rooting depth is restricted by the underlying bedrock, trees are occasionally subject to windthrow when the soil is wet and winds are strong.

Ponderosa pine is the principal tree species on the Klicker soil. Douglas fir is of limited extent. The habitat type is generally ponderosa pine-snowberry. On the basis of a 100-year site curve, the mean site index is 78 for ponderosa pine on the Klicker soil. The highest average growth rate in unmanaged, even-aged stands is 66 cubic feet per acre per year for ponderosa pine at age 40. In a typical basal area, however, the composition of ponderosa pine is reduced by about 65 percent and growth rates are reduced accordingly.

The main limitations affecting timber harvesting on the Klicker soil are the stoniness and the muddiness caused by seasonal wetness. The stones on the surface hinder harvesting activities. When felled, the timber can break on the stones. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced roads are sticky and slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is readily available on this unit.

Equipment and logs on the surface can result in a high degree of compaction and puddling when the Klicker soil is wet or moist and a moderate degree of displacement when the soil is dry. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, displacement, and erosion. A moderate reduction in soil productivity can result from unmanaged fires in undisturbed areas.

Seedling establishment is the main concern affecting the production of timber on the Klicker soil. Droughtiness in the surface layer reduces the seedling survival rate. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are available, natural reforestation by ponderosa pine occurs readily in cutover areas and reforestation of Douglas fir occurs periodically. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means. Because the rooting depth is restricted by the underlying bedrock, trees are occasionally subject to windthrow when the soil is wet and winds are strong.

The forest understory vegetation is pinegrass, common snowberry, Idaho fescue, and bluebunch wheatgrass on the Sweiting soil and common snowberry, bluebunch wheatgrass, elk sedge, and pinegrass on the Klicker soil. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as mountain brome, prairie junegrass, and Idaho fescue, decreases and the proportion of the less preferred forage plants, such as annual bromes, annual bluegrasses, and snowberry, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning. The density of the overstory generally is the main factor that limits the kind and amount of vegetation.

The main limitations affecting seeding are the low available water capacity and surface stoniness of the Klicker soil. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder. In some areas the Sweiting soil can be seeded with a rangeland drill. Undesirable plants can be controlled by chemical treatment prior to seeding. The stones on the Klicker soil interfere with the installation of fences and watering facilities.

The Sweiting soil is in capability subclass IVe, nonirrigated. The Klicker soil is in capability subclass VIIs, nonirrigated.

108-Tolo silt loam, 3 to 30 percent slopes. This deep, well drained soil is on north-facing mountain plateaus. It formed in a mantle of volcanic ash over loess and in colluvium derived from weathered basalt. The native vegetation is mainly conifers. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface is covered with a mat of partially decomposed needles and twigs about 3 inches thick. The surface layer is brown silt loam about 6 inches thick. The subsoil is about 17 inches of light yellowish brown silt loam. Below this is a buried subsoil. The upper 24 inches of the buried subsoil is yellowish brown silt loam. The lower 8 inches is yellowish brown gravelly silty clay loam, which is underlain by basalt at a depth of about 55 inches. The depth to basalt ranges from 40 to 60 inches.

Permeability is moderately slow. Available water capacity is very high. The effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

Included in this unit are areas of Olot silt loam, Cloverland silt loam, and Tolo soils that have slopes of more than 30 percent. Also included are some areas where the depth to basalt is more than 60 inches. The included areas make up about 25 percent of the unit.

This unit is used as grazeable woodland or wildlife habitat. Grand fir and Douglas fir are the principal tree species. The trees of limited extent include ponderosa pine and western larch. The habitat type is generally grand fir-pachistima. On the basis of a 50-year site curve, the mean site index is 63 for grand fir and 72 for Douglas fir. The highest average growth rate in unmanaged, even-aged stands is 81 cubic feet per acre per year for grand fir at age 118 and 63 cubic feet per acre per year for Douglas fir at age 102. In a typical basal area, however, the composition of grand fir is reduced by about 75 percent and the composition of Douglas fir is reduced by about 95 percent. Growth rates are reduced accordingly.

The main limitations affecting timber harvesting are occasional snowpack and the muddiness caused by seasonal wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced logging roads are soft, sticky, and slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit. On unsurfaced logging roads, measures that abate dustiness during dry periods are needed to reduce road surface degradation and improve visibility.

Equipment and logs on the surface can result in a high degree of compaction and puddling when the soil is wet or moist and a moderate degree of displacement when the soil is dry. Steep skid trails and firebreaks are subject to rilling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, displacement, and erosion. A moderate reduction in soil productivity can result from unmanaged fires in undisturbed areas.

Seedling establishment is the main concern affecting the production of timber. Reforestation can be accomplished by planting Douglas fir or ponderosa pine seedlings. If seed trees are available, natural reforestation by grand fir, Douglas fir, western larch, and ponderosa pine occurs readily in cutover areas. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means.

The forest understory vegetation is common snowberry, huckleberry, and longtube twinflower. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue and blue wildrye, decreases and the proportion of the less preferred forage plants, such as snowberry, ceanothus, and pinegrass, increases. The density of the overstory is the main factor that limits the kind and amount of vegetation. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder.

This unit is in capability subclass IVe, nonirrigated.

109-Tolo silt loam, 30 to 45 percent slopes. This deep, well drained soil is on north-facing hillslopes. It formed in a mantle of volcanic ash over loess and in colluvium derived from weathered basalt. The native vegetation is mainly conifers. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface is covered with a mat of partially decomposed needles and twigs about 3 inches thick. The surface layer is brown silt loam about 6 inches thick. The subsoil is about 17 inches of light yellowish brown silt loam. Below this is a buried subsoil. The upper 24 inches of the buried subsoil is yellowish brown silt loam. The lower 8 inches is yellowish brown gravelly silty clay loam, which is underlain by basalt at a depth of about 55 inches. The depth to basalt ranges from 40 to 60 inches. In some areas the mantle of volcanic ash is 14 to 20 inches thick.

Permeability is moderately slow. Available water capacity is very high. The effective rooting depth is 40 to 60 inches. Runoff is rapid, and the hazard of water erosion is severe.

Included in this unit are areas of Olot silt loam, Cloverland silt loam, and Tolo soils that have slopes of less than 30 percent or more than 45 percent. Also included are some areas where the depth to basalt is more than 60 inches. The included areas make up about 25 percent of the unit.

This unit is used as grazeable woodland or wildlife habitat. Grand fir and Douglas fir are the principal tree species. The trees of limited extent include ponderosa pine and western larch. The habitat type is generally grand fir-pachistima. On the basis of a 50-year site curve, the mean site index is 63 for grand fir and 72 for Douglas fir. The highest average growth rate in unmanaged, even-aged stands is 81 cubic feet per acre per year for grand fir at age 118 and 63 cubic feet per acre per year for Douglas fir at age 102. In a typical basal area, however, the composition of grand fir is reduced by about 75 percent and the composition of Douglas fir is reduced by about 95 percent. Growth rates are reduced accordingly.

The main limitations affecting timber harvesting are the slope, occasional snowpack, and the muddiness caused by wetness. During an average year, snowpack limits the use of equipment and restricts access from December through March. Unsurfaced logging roads are soft, sticky, and slippery when wet and can be impassable during rainy periods. They require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit. Cut and fill slopes are somewhat erodible. Establishing a plant cover in these disturbed areas reduces the hazard of erosion. On unsurfaced logging roads, measures that abate dustiness during dry periods are needed to reduce road surface degradation and improve visibility.

Equipment and logs on the surface can result in a high degree of compaction and puddling when the soil is wet or moist and a moderate degree of displacement when the soil is dry. Steep skid trails and firebreaks are subject to rilling and gullying unless protected by adequate water bars or a plant cover. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazards of compaction, puddling, displacement, and erosion. A moderate reduction in soil productivity can result from unmanaged fires in undisturbed areas.

Seedling establishment is the main concern affecting the production of timber. Reforestation can be accomplished by planting Douglas fir or ponderosa pine seedlings. If seed trees are available, natural reforestation by grand fir, Douglas fir, western larch, and ponderosa pine occurs readily in cutover areas. If not controlled, invading brushy plants can delay the establishment of seedlings when openings are made in the canopy. Competing vegetation can be controlled by mechanical or chemical means.

The forest understory vegetation is common snowberry, huckleberry, pinegrass, blue wildrye, longtube twinflower, and heartleaf arnica. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as Idaho fescue, blue wildrye, and rose, decreases and the proportion of the less preferred forage plants, such as snowberry, ceanothus, and pinegrass, increases. Areas that are logged, burned, or otherwise disturbed can be seeded aerially or with a hand seeder.

This unit is in capability subclass VIe, nonirrigated.

110-Tyee-Rock outcrop complex, 40 to 90 percent slopes. This map unit is on south-facing canyon walls. The native vegetation is mainly grasses. Elevation is 1,000 to 2,400 feet. The average annual precipitation is 16 or 17 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

This unit is about 65 percent Tyee gravelly sandy loam and 15 percent Rock outcrop. The Tyee soil is in concave areas, and the Rock outcrop is in convex areas. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of soils that have weathered granodiorite at a depth of less than 10 inches or more than 20 inches and Tyee soils that have slopes of less than 40 or more than 90 percent. The included areas make up about 20 percent of the unit.

The Tyee soil is shallow and well drained. It formed in residuum and colluvium derived from weathered granodiorite. Typically, the upper 8 inches of the surface layer is dark grayish brown gravelly sandy loam. The lower 6 inches is dark grayish brown gravelly coarse sandy loam, which is underlain by weathered granodiorite at a depth of about 14 inches. The depth to weathered granodiorite ranges from 10 to 20 inches.

Permeability is moderate in the Tyee soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

The Rock outcrop is granodiorite.

This unit is used as rangeland or wildlife habitat. The production of vegetation is limited by the very low available water capacity. The slope and the Rock outcrop limit access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, arrowleaf balsamroot, and fleabane. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Sandberg bluegrass, decreases and the proportion of the less preferred forage plants, such as cheatgrass, other annual bromes, and annual forbs, increases.

Mechanical seeding generally is not practical because of the slope, the Rock outcrop, and the very low available water capacity in the Tyee soil. The slope and the Rock outcrop interfere with the installation of fences and watering facilities.

The Tyee soil is in capability subclass VIIe, nonirrigated. The Rock outcrop is not assigned to a capability subclass.

111-Tyee Variant loam, 40 to 90 percent slopes. This deep, well drained soil is on north-facing canyon walls. It formed in loess and colluvium derived from weathered granodiorite. The native vegetation is mainly grasses. Elevation is 1,000 to 2,400 feet. The average annual precipitation is 16 or 17 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 145 days.

Typically, the surface layer is very dark gray loam about 22 inches thick. The upper 13 inches of the subsoil is dark grayish brown sandy clay loam. The lower 10 inches is dark grayish brown gravelly sandy clay loam, which is underlain by weathered granodiorite at a depth of about 45 inches. The depth to weathered granodiorite ranges from 40 to 60 inches.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Runoff is very rapid, and the hazard of water erosion is very severe.

Included in this unit are areas of Tyee gravelly sandy loam and Tyee Variant soils that have slopes of less than 40 percent or more than 90 percent. Also included are some areas where the depth to weathered granodiorite is more than 60 inches. The included areas make up about 25 percent of the unit.

This unit has few limitations in areas used as rangeland or wildlife habitat. The slope limits access by livestock and thus can result in overgrazing of the less sloping areas.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and balsamroot. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass and Sandberg bluegrass, decreases and the proportion of the less preferred forage plants, such as cheatgrass, other annual bromes, and annual forbs, increases.

The steep north-facing slopes are hazardous to livestock when the soil is frozen or snow covered. Under such conditions, the site can become extremely slippery. If the livestock slip and fall, the result can be injury or death. The soil remains saturated late into the spring. Deferred grazing helps to prevent excessive compaction and trampling by livestock.

Mechanical seeding generally is not practical because of the slope. Steep areas that are burned or otherwise disturbed can be seeded aerially or with a hand seeder. The slope interferes with the installation of fences and watering facilities.

This unit is in capability subclass VIIe, nonirrigated.

112-Veazie silt loam, 0 to 3 percent slopes. This very deep, well drained soil is on flood plains and low terraces. It is subject to rare flooding. It formed in alluvium. The native vegetation is mainly shrubs and grasses. Elevation is 750 to 1,600 feet. The average annual precipitation is 12 to 19 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 120 to 150 days.

Typically, the upper 17 inches of the surface layer is dark grayish brown silt loam. The lower 18 inches is dark grayish brown gravelly loam. The underlying material to a depth of 60 inches or more is dark gray extremely cobbly coarse sand. In some areas the surface layer is very fine sandy loam, gravelly loam, or loam.

Permeability is moderate in the surface layer and very rapid in the underlying material. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit are occasionally flooded areas on flood plains, areas of soils that have a surface layer of cobbly loam or stony sandy loam, and Veazie soils that have slopes of more than 3 percent. Also included are some areas where the underlying material is extremely cobbly coarse sand at a depth of more than 40 inches. The included areas make up about 20 percent of the unit.

This unit is used as nonirrigated and irrigated cropland or as rangeland. Few limitations affect nonirrigated cropland. A 3-year rotation of winter wheat, spring barley, and fallow is suitable. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion.

This unit has few limitations in the areas used for irrigated crops. The main irrigated crops are small grain, grass or grass-alfalfa for hay or pasture, and corn. Furrow, corrugation, trickle, and sprinkler irrigation systems are suitable. Excessive water application rates can result in puddling, which impairs aeration and reduces the rate of water intake. Erosion can be minimized by reducing the size of the irrigation stream. Minimizing tillage and returning crop residue to the soil help to maintain or increase the organic matter content, help to maintain tilth, and increase the rate of water infiltration. Including close-growing, high-residue crops in the rotation and keeping crop residue on the surface help to control water erosion.

The potential native vegetation is bluebunch wheatgrass, sand dropseed, and basin wildrye. If the vegetation is overgrazed. the proportion of the preferred forage plants, such as sand dropseed and bluebunch wheatgrass, decreases and the proportion of the less preferred forage plants, such as threeawn, needleandthread, Scotch cottonthistle, teasel, yarrow, and fleabane daisy, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment or prescribed burning.

This soil is suited to range seeding with a rangeland drill, a disk drill, or a deep-furrow drill. Undesirable plants can be controlled by chemical or mechanical treatment.

This unit is in capability subclass IIw, irrigated and nonirrigated.

113-Veazie silt loam, flooded, 0 to 3 percent slopes. This very deep, well drained soil is on flood plains. It is subject to occasional flooding from January through May. It formed in alluvium. The native vegetation is mainly shrubs and grasses. Elevation is 750 to 1,600 feet. The average annual precipitation is 12 to 19 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 120 to 150 days.

Typically, the upper 17 inches of the surface layer is dark grayish brown silt loam. The lower 18 inches is dark grayish brown gravelly loam. The underlying material to a depth of 60 inches or more is dark gray extremely cobbly coarse sand. In some areas the surface layer is very fine sandy loam, gravelly loam, or loam.

Permeability is moderate in the surface layer and very rapid in the underlying material. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Included in this unit are areas on alluvial fans that are subject to rare flooding, soils that have a surface layer of cobbly loam or stony sandy loam, and Veazie soils that have slopes of more than 3 percent. Also included are some areas where the underlying material is extremely cobbly coarse sand at a depth of more than 40 inches. The included areas make up about 20 percent of the unit.

This unit is used as nonirrigated and irrigated cropland. Flooding is the main hazard affecting nonirrigated cropland. It can be controlled by dikes, levees, or diversions. A 3-year rotation of winter wheat, spring barley, and fallow is suitable. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion.

The main irrigated crops are small grain, corn, and grass or grass and alfalfa for hay or pasture. Flooding is the main hazard. It can be controlled by dikes, levees, or diversions. Furrow, corrugation, trickle, and sprinkler irrigation systems are suitable. Excessive water application rates can result in puddling, which impairs aeration and reduces the rate of water intake. Erosion can be minimized by reducing the size of the irrigation stream. Minimizing tillage and returning crop residue to the soil help to maintain or increase the organic matter content, help to maintain tilth, and increase the rate of water infiltration. Including close-growing, high-residue crops in the rotation and keeping crop residue on the surface help to control water erosion. Growing cover crops helps to control erosion in orchards and vineyards.

This unit is in capability subclass IIIw, nonirrigated and irrigated.

114-Veazie-Veazie Variant complex, 0 to 3 percent slopes. This map unit is on flood plains and alluvial fans (fig. 5). It is subject to occasional flooding from January through May. The native vegetation is

Figure 5.-An area of Veazie-Veazie Variant complex, 0 to 3 percent slopes, on a flood plain between areas of Lickskillet-Schuelke-Rock outcrop complex, 40 to 90 percent slopes, on the right and Asotin-Lickskillet-Rock outcrop complex, 40 to 90 percent slopes, on the left.

mainly trees, shrubs, and grasses. Elevation is 750 to 2,500 feet. The average annual precipitation is 12 to 19 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 120 to 150 days.

This unit is about 50 percent Veazie silt loam and 30 percent Veazie Variant cobbly loam. The Veazie soil is on flood plains, and the Veazie Variant is on flood plains that border streams. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas that are subject to frequent or rare flooding, Veazie soils that have a surface layer of cobbly loam or stony sandy loam, and soils that have slopes of more than 3 percent. Also included are some areas where the depth to extremely cobbly coarse sand is more than 40 inches. The included areas make up about 20 percent of the unit.

The Veazie soil is very deep and well drained. It formed in alluvium. Typically, the upper part of the surface layer is dark grayish brown silt loam about 17 inches thick. The lower 18 inches is dark grayish brown gravelly loam. The underlying material to a depth of 60 inches or more is dark gray extremely cobbly coarse sand. In some areas the surface layer is very fine sandy loam, loam, or gravelly loam.

Permeability is moderate in the surface layer of the Veazie soil and very rapid in the underlying material. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

The Veazie Variant is very deep and moderately well drained. It formed in alluvium. Typically, the upper 6 inches of the surface layer is dark grayish brown cobbly loam. The next 7 inches is dark grayish brown very cobbly loam. The lower 20 inches is. dark grayish brown extremely cobbly loam. The underlying material to a depth of 60 inches or more is grayish brown, mottled extremely cobbly coarse sand. In some areas the surface layer is very fine sandy loam, loam, or gravelly loam.

Permeability is moderate in the surface layer of the Veazie Variant and very rapid in the underlying material. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The seasonal high water table is at a depth of 36 to 60 inches during the period January through May.

This unit is used mainly as nonirrigated and irrigated cropland. It also is used for hay and pasture, grazeable woodland, and homesite development. The main limitations affecting nonirrigated cropland are the hazard of flooding and the low available water capacity of the Veazie Variant. A 3-year rotation of winter wheat, spring barley, and fallow is suitable.

The main irrigated crops are small grain, grass or grass-alfalfa for hay, pasture, and corn. The main limitations are the low available water capacity of the Veazie Variant and the hazard of flooding on both soils. Furrow, corrugation, trickle, and sprinkler irrigation systems are suitable. If sprinklers are used, excessive water application rates can result in puddling, which impairs aeration and reduces the rate of water intake. Erosion can be minimized by reducing the size of the irrigation stream. Minimizing tillage and returning crop residue to the soil help to maintain or increase the organic matter content, help to maintain tilth, and increase the rate of water infiltration. Including close-growing, high-residue crops in the rotation and keeping crop residue on the surface help to control water erosion. Growing cover crops helps to control erosion in orchards and vineyards.

Few limitations affect the production of vegetation on the Veazie soil. The potential native vegetation on this soil is mainly bluebunch wheatgrass, sand dropseed, wildrye, and needleandthread. The forest understory vegetation on the Veazie Variant is mainly hawthorn, common snowberry, and wildrye. If the vegetation is overgrazed, the proportion of the preferred forage plants, such as bluebunch wheatgrass, decreases and the proportion of the less preferred plants, such as quackgrass, annual bromes, houndstongue, thistle, and annual forbs, increases. Areas that have an excessive number of undesirable shrubs can be improved by chemical treatment.

This soil is suited to seeding with a rangeland drill. It also is suited to broadcast seeding if the seed is covered through harrowing. Chemical or mechanical treatment prior to seeding helps to control plant competition. The cobbles on the Veazie Variant interfere with the installation of fences and watering facilities.

This unit is well suited to hay and pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and minimize compaction. The cobbles on or near the surface may limit seedling establishment on the Veazie Variant.

Black cottonwood is the principal tree species on Veazie Variant. Thinleaf alder is of limited extent. On the basis of a 50-year site curve, the estimated mean site index is 80 for black cottonwood. The highest average growth rate in unmanaged, even-aged stands is estimated to be 35 cubic feet per acre per year for black cottonwood at age 60.

During an average year, snowpack limits the use of equipment and restricts access from December through March. Rounded pebbles and cobbles for road construction are readily available on this unit. Equipment or logs on the surface when the soil is moist can result in a moderate degree of compaction. Carefully laying out skid trails, properly timing their use, and using low-pressure ground equipment can reduce the hazard of compaction. A moderate reduction in soil productivity can result from unmanaged fires in undisturbed areas.

High summer temperatures and low summer precipitation reduce the seedling survival rate. Reforestation can be accomplished by planting black cottonwood seedlings. If seed trees are available, natural reforestation by black cottonwood occurs readily in cutover areas.

Flooding is the main hazard affecting homesites. Small stones can interfere with the ease of excavation. These sites should be disturbed as little as possible. The main limitations affecting septic tank absorption fields are flooding and a poor filtering capacity. Dikes and channels that have outlets to divert floodwater can

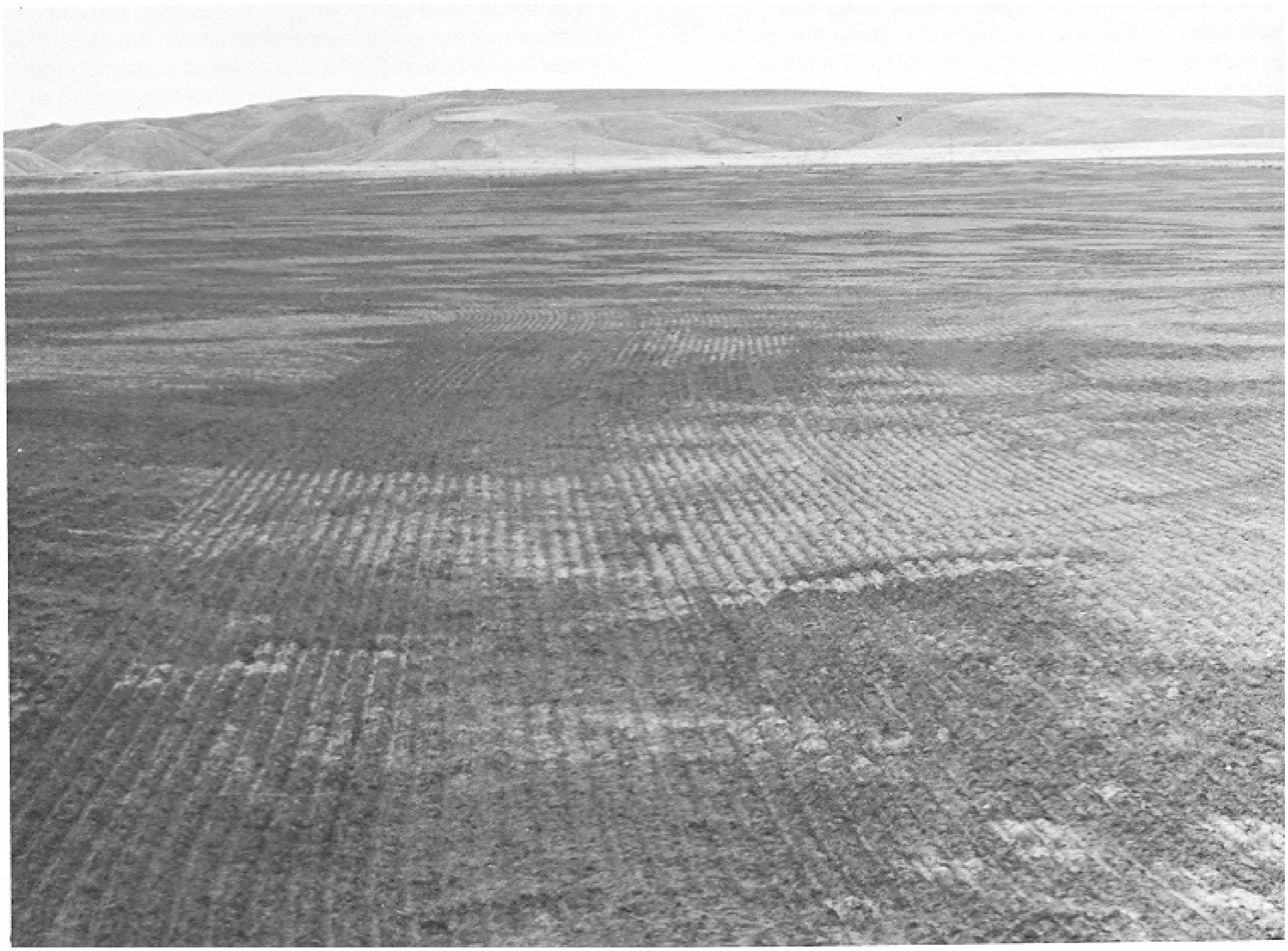

Figure 6.-An area of Weissenfels-Nims silt loams, 3 to 8 percent slopes, on a plateau. The Weissenfels soil is in the darker areas, and the Nims soil is in the lighter areas.

protect buildings and onsite sewage disposal systems. If the density of housing is moderate or high, community sewage systems are needed to prevent the contamination of water supplies caused by seepage. Cutbanks are not stable and are subject to slumping. Establishing lawns is difficult in areas where the surface layer has been removed. Mulching and applying fertilizer in cut areas help to establish plants.

The Veazie soil is in capability subclass IIIw, irrigated and nonirrigated. The Veazie Variant is in capability subclass IIIw, nonirrigated.

115-Weissenfels-Nims silt loams, 3 to 8 percent slopes. This map unit is on plateaus (fig. 6). The native vegetation is mainly grasses. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

This unit is about 45 percent Weissenfels silt loam and 30 percent Nims silt loam. The Weissenfels soil occurs as circular, concave slick spots, and the Nims soil is in areas between the slick spots. The components of this unit occur as areas so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Olical silt loam, Spofford silt loam, and Weissenfels soils that have slopes of more than 8 percent. The included areas make up about 25 percent of the unit.

The Weissenfels soil is moderately deep and moderately well drained. It formed in loess and slope alluvium derived from weathered basalt. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper 8 inches of the subsoil is grayish brown silty clay and brown silty clay loam. The next 7 inches is brown silt loam. The lower 15 inches is very pale brown and white very gravelly loam, which is underlain by basalt at a depth of about 37 inches. The upper part of subsoil has a high content of sodium. The depth to basalt ranges from 25 to 40 inches. The soil is calcareous below a depth of about 15 inches.

Permeability is slow in the Weissenfels soil. Available water capacity is moderate. The effective rooting depth is 25 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Nims soil is moderately deep and well drained. It formed in loess and in material weathered from basalt. Typically, the surface layer is dark grayish brown silt loam about 15 inches thick. The upper 11 inches of the subsoil is brown silt loam. The lower 9 inches is white very cobbly and very gravelly loam, which is underlain by basalt at a depth of about 35 inches. The depth to basalt ranges from 30 to 40 inches. The soil is calcareous below a depth of about 19 inches.

Permeability is moderate in the Nims soil. Available water capacity is high. The effective rooting depth is 30 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as nonirrigated cropland. The main limitations are the low annual precipitation, the hazard of water erosion, and the high content of sodium in the subsoil of the Weissenfels soil. Because the amount of precipitation is not sufficient for growing annual grain, a cropping system that includes winter wheat and fallow or winter wheat, barley, and fallow is needed. Fallowing is necessary if the amount of winter precipitation is exceptionally low. The amount of crop residue produced by spring crops is low. As a result, careful management during fallow periods is needed to control water erosion. On fallow fields the hazard of water erosion can be reduced by seeding fall grain early and by stubble mulching.

Stubble mulching helps to control erosion after fall seeding in a wheat-fallow rotation. Chiseling stubble fields across the slope when the soil is dry shatters restrictive layers and increases the rate of water intake. Tillage implements, such as moldboard plows, may bring soil material high in content of sodium to the surface. Chisel plows, cultivators, and noninversion tillage implements that bring less sodium to the surface are preferred.

Terraces reduce the length of slopes. They help to prevent excessive runoff, concentrated flow, and rill erosion. Caution is needed in constructing the terraces because of the depth to basalt. Stripcropping can help to control water erosion on long slopes.

This unit is in capability subclass IIIe, nonirrigated.

Prime Farmland

Prime farmland is of major importance in meeting the Nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. The soil properties, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland may presently be cropland, pasture, or woodland, or it may be used for other purposes. It either is used for food and fiber crops or is available for those crops. Urban or built-up land, public land, and water areas are not considered prime farmland. Urban or built-up land is any contiguous tract 10 or more acres in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water-control structures. Public land is land that is not available for farming in national forests, in national and state parks, and on military reservations.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. Soils in areas where the average annual air temperature is less than 43 degrees F are not considered prime farmland. More information about the criteria for prime farmland can be obtained at the local office of the Soil Conservation Service.

A recent trend in land use in the survey area has been the conversion of prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on lands that are less productive than prime farmland.

About 13,580 acres, or nearly 4 percent of the survey area, meets the requirements for prime farmland. The map units that meet the requirements are listed in table 5. This list does not constitute a recommendation for a particular land use. The location of each map unit is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units."

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock or wetness can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Ron McClellan, area agronomist, and Lucius Tilden, range conservationist, Soil Conservation Service, assisted in writing this section.

General management needed for crops and pasture is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed.

Planners of management systems for individual soils or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 86,500 acres in the survey area is used as cropland and 8,820 acres as hayland or pasture. The principal nonirrigated crops are wheat, barley, peas, grass for seed, and hay. About 50 acres of irrigated cropland is used for orchards and 290 acres for vegetables, hay, or pasture. The irrigated cropland is mainly on terraces above Clarkston and on flood plains and terraces adjacent to Alpowa Creek, Asotin Creek, and the Grande Ronde and Snake Rivers. Chard and Veazie are examples of soils used as irrigated cropland. Most of the produce grown in the survey area is consumed locally. About 2,000 acres of agricultural land in the vicinity of Clarkston and Asotin has been converted to urban uses during the past 20 years. The acreage used for orchards has declined from 100 to 50 acres.

Management of Cropland

Crop rotations and the selection of crops that are suited to the soils and the climatic conditions help to maintain fertility, improve tilth, and help to control water erosion, plant diseases, insects, and weeds. During the growing season, the most important factor in reducing the hazard of erosion on cropland is the amount of surface protection provided by crops, crop residue, and surface roughness. Annual cropping, crop rotations, and limited fallow help to control runoff and water erosion and increase the rate of water infiltration. Also, annual cropping results in a more efficient use of precipitation because a crop is grown a greater proportion of the time. Areas where the average annual precipitation is 18 inches or more are cropped annually.

Including grasses and legumes for forage or for grass seed in the crop rotation reduces the hazard of water erosion on sloping land. Nodules on legumes provide nitrogen to plants and improve tilth for the following crop. Cereal crops respond well to applications of nitrogen and sulfur fertilizer on most of the cultivated soils in the survey area. On some of the soils, crops respond well to applications of phosphorus. Boron fertilizer is used on some soils with a long history of alfalfa production. All fertilizer programs should be based on the results of soil tests.

In areas where the average annual precipitation is less than 18 inches, summer fallow may be needed once every 2 or 3 years to provide a moist seed zone for the early germination of winter cereal crops. Summer fallow generally helps to control weeds and diseases.

Crop yields vary from one season to the next because of changes in growing conditions, especially changes in the amount and distribution of precipitation. The depth and available water capacity of soils greatly influence crop yields. Alpowa Variant, Ferdinand, Neconda, Neissenberg, Nims, Pataha, Peola, Snell, Stember, Sweiting, and Weissenfels soils are moderately deep over basalt. As a result, the available water capacity is limited. The average precipitation from October to March fills the soil profile with moisture. Annual cropping results in the efficient use of soil moisture during the growing season and permits storage of more winter precipitation the following year. Summer fallow on these soils commonly increases the runoff rate and the hazard of erosion during the following winter.

Terraces and grassed waterways have been used extensively on almost all of the cropland in the survey area. Water catchment basins at terrace outlets help to control the erosion caused by concentrated flow. Stripcropping and divided-slope farming can help to reduce the runoff rate on fields with long slopes. Cross-slope tillage prior to fall and winter precipitation increases the rate of water infiltration and helps to control runoff and erosion. By orienting the plow furrow up the slope, uphill plowing can conserve water and reduce the hazard of erosion.

Surface crusting is a problem on soils that have a high content of sodium in the subsoil, such as Spofford, Spofmore, Neissenberg, and Weissenfels soils. Conservation tillage systems that keep large amounts of protective crop residue on the surface during periods of high precipitation reduce the runoff rate. Tillage implements, such as moldboard plows, may bring the soil material high in content of sodium to the surface. Chisel plows, cultivators, and subsurface tillage implements bring less sodium to the surface.

Most of the soils used as cropland have a surface layer of fine sandy loam, loam, silt loam, or silty clay loam. The content of organic matter in these soils decreases with cultivation. Regular additions of crop residue increase the content and help to maintain soil structure and good tilth. Organic matter is an important source of plant nutrients, especially nitrogen, phosphorus, and sulfur.

Soil compaction can result from working a soil when it is too wet, from working it excessively, or from using heavy equipment. Compaction reduces the rate of water intake, increases the hazard of erosion, and restricts aeration and internal soil drainage.

Management of Pasture

Approximately 5,000 acres in the survey area is used as improved pasture. The pasture is mainly in areas where the soils are steep, are shallow, or have a low available water capacity or a short growing season. Chard, Cloverland, Ferdinand, Nims, Snell, Stember, Sweitberg, and Sweiting soils are used as pasture.

Forage production can be maintained or improved by selecting suitable grasses and legumes for planting and by delaying grazing in spring until after the plants have reached an adequate height and the soils are sufficiently dry. Grazing when the soils are wet results in compaction and trampling damage. Other measures that can improve the pasture are cross fencing, properly distributed watering facilities, periodic clipping, spreading of livestock droppings, and a fertilizer program that includes applications of nitrogen and sulfur fertilizer. On some soils phosphorus fertilizer may be needed if legumes are grown alone or in a mixture with grasses. The results of soil fertility tests can provide useful information in the development of a satisfactory fertilizer program.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (23). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils generally are grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, e, w, s, or *c.* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s, or c because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Lucius W. Tilden, area range conservationist, Soil Conservation Service, assisted in writing this section.

About 72 percent of the survey area is grazed by livestock during part of the year. The grazed areas include about 31,000 acres of grazeable woodland and 237,570 acres of rangeland. After crops are harvested, 20,000 to 40,000 acres of cropland is grazed each year.

A large elk herd inhabits the survey area. The elk graze the woodland in the higher mountainous areas in late spring and in summer and fall and move to the lower ridges and canyons for winter and early spring forage. Both whitetail deer and mule deer are common in the survey area.

The livestock industry began in Asotin County during the period between 1862 and 1870, at the same time as Lewiston, Idaho, became a supply center for the growing mining industry in the area. During the early years of the livestock industry, large herds of horses were required in land breaking, seeding, and harvesting and in transporting goods. The range sheep industry was extensive, using the lowlands from early spring to early summer and the rangeland and woodland in the uplands through summer and early fall. These uses, which have discontinued, had a great effect on the native plant community of the rangeland, especially in the lower canyons and on the lower ridges. Cattle and a few horses currently graze the rangeland in the survey area.

Cow-calf and yearling enterprises are the most common systems of beef production. They are fairly evenly distributed throughout the grazing land in the survey area. The spring and fall range is primarily along the bottoms and steep sides of northeast-trending canyons and on the steep sides of the canyons along the Snake River. The summer range is in the upland areas of the Blue Mountains, in the southern and western parts of the survey area.

During the period December 1 through March 15, cattle are fed at the ranch headquarters. Calving takes place primarily from late January to early March on the ranches in the lower canyons. Grazing along the lower slopes begins during the period mid-March to April, and the cattle move upward as the grazing season progresses. In the higher areas, such as the areas near Anatone, grazing begins during the period from about April 15 to May 1. By the period June 1 to 15, the cattle have been moved to timbered areas or the higher ridges, where they remain until late September or October. A considerable number of cattle, especially those from the ranches in the lower canyons, are moved for summer grazing to timbered areas in Idaho, mainly in the area from St. Maries south to Weippe. Some cattle from the Grande Ronde area are moved into Oregon for summer grazing, primarily on private land and large timber company holdings but also on some national forest grazing land.

Annual forage production on the rangeland varies more with annual precipitation than is typical on the grazeable woodland. The soils in these areas range from loamy fine sands, loamy, and light colored silt loamy to heavy textured, very dark soils in the uplands. Examples are Asotin, Bolicker, Gwinly, Laufer, Lickskillet, Mallory, Matheny, Rockly, Schuelke, and Snell soils. Nearly all these soils, except for a small acreage of sandy soils, have good potential for bluebunch wheatgrass, Sandberg bluegrass, prairie junegrass, and Idaho fescue. The proportion of these species varies, depending on slope aspect and soil depth. Overgrazing allows cheatgrass, other annual bromes, goatweed, Scotch thistle, and other annual weeds to invade. Where effective range management is applied, optimum forage production can be maintained and maximum use of the rangeland can be made without range deterioration.

Snowberry, rose, Oregongrape, bluebunch wheatgrass, Idaho fescue, prairie junegrass, balsamroot, and lupine are commonly the principal understory plants at the lower elevations where the precipitation limits are less favorable, in the forested zone, and on very stony, moderately deep soils on ridgetops in other forested areas. Ponderosa pine is the principal tree species in these areas. The overstory canopy is usually light or moderate, and forage production usually decreases as the canopy increases. Tamming and Klicker are examples of soils in areas of this forest type.

In areas where the annual precipitation is more than 22 inches, the kind of vegetation changes from range plants to grazeable woodland species. In these areas ponderosa pine and Douglas fir form a sparse to dense canopy, resulting in a decrease in the extent of grasses and an increase in the extent of forbs and shrubs. The soils can support bluebunch wheatgrass, Idaho fescue, prairie junegrass, needlegrasses, blue wildrye, pinegrass, and various forbs and shrubs. Cloverland and Getaway are examples of soils in these areas.

Crackercreek, Olot, Tolo, and other soils that have a mantle of volcanic ash support mixed forest species, including ponderosa pine, Douglas fir, larch, grand fir, Engelmann spruce, and lodgepole pine. They can support pinegrass, prairie junegrass, elk sedge, needlegrasses, blue wildrye, and numerous forbs and shrubs. Forage production decreases as the tree canopy increases. It is very limited where the canopy is more than 40 to 65 percent.

The wooded soils produce much less forage than the soils in areas of rangeland. After a timber harvest or a fire reduces the forest canopy, however, forage production increases. It then gradually decreases as the canopy closes up. Following logging activities, the skid trails, roads, landings, and other disturbed areas are generally seeded to suitable grasses and forbs, which produce substantial amounts of forage and provide protection against water erosion.

The current forage production in the survey area is two-thirds to three-fourths of the potential because the natural vegetation in many areas has been greatly depleted by past and present excessive use. Where practical, seeding the rangeland and grazeable woodland that has deteriorated to a poor condition is advisable on most soils. If slopes are more than 30 percent or the soils are very stony, broadcast seeding with aerial equipment is the most effective method of seeding. On soils that have slopes of less than 30 percent and do not have a significant number of stones, seeding with ground equipment on a firm, well packed seedbed is the most effective method. Deferment of grazing once every 2 or 3 years until grass seeds are ripe and plants can regain vigor helps to maintain the forage and improves the ecological condition.

Other management practices that are suitable on the rangeland and grazeable woodland in the survey area are proper range use, proper woodland grazing, and a planned grazing system. Properly locating salt licks, watering facilities, and fences and establishing livestock trails can improve the distribution of livestock grazing. In some areas the initial stocking rate is significantly affected by the population of wildlife, which varies greatly from one area to another.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 8 shows, for many of the soils, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 8 follows.

A range site is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruit of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation-the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil-is listed by common name. Under *composition,* the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimal production of vegetation, reduction of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Woodland Management and Productivity

About 31,000 acres in the survey area, or 8 percent of the total acreage, is commercial forest land. Of this total, about 28,000 acres is owned by farmers and other nonindustrial owners and 3,000 acres is owned and managed by the Washington State Department of Natural Resources. The survey area includes 5,000 acres of the Umatilla National Forest (6).

The survey area has a variety of forest cover types. Ponderosa pine is common on south- and southwest-facing slopes and extends onto upland plateaus. Douglas fir is dominant along canyon floors and on north-facing slopes. It is gradually replaced as the dominant species by grand fir, Engelmann spruce, and subalpine fir as elevation and the amount of rainfall increase. Lodgepole pine and western larch can rapidly invade recently disturbed areas and replace Douglas fir, grand fir, Engelmann spruce, and subalpine fir as the dominant species *(10, 20).*

Diseases and insects vary in their effects on the trees in the survey area. Dwarf mistletoe is common to western larch and Douglas fir but is not widespread. Larch casebearer is common but is generally not of major importance. Douglas fir needlecast and various root rots are of local concern.

Soil surveys are becoming increasingly more important to forest managers as they seek ways of increasing the productivity of their forested lands. Plants respond better to applications of fertilizer on some soils than on others. Some soils are susceptible to landslides and erosion after road building and harvesting, and others require special effort to harvest and reforest.

Table 9 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. Under the heading "Detailed Soil Map Units," the descriptions of the suitable map units provide information concerning forest productivity, the limitations that affect harvesting and producing timber, and the common forest understory plants. Table 9 summarizes forestry information given in the map unit descriptions and can serve as a quick reference for important forestry interpretations. Map unit symbols are listed, and the ordination (woodland suitability) symbol for each map unit shown in the table is given. All soils having the same ordination symbol require the same general kinds of forest management and have about the same potential productivity.

The *ordination symbol* is based on a uniform system that indicates the potential productivity of an individual soil and the principal hazards or limitations of that soil. The first element of the ordination symbol is a number that denotes the potential productivity in terms of cubic meters of wood per hectare per year for the indicator tree species, which is the species listed first in the map unit descriptions and in the column "Common trees" in table 9. The potential productivity is based on the site index and the corresponding culmination of the mean annual increment (1, 2, *8, 16, 17).* For example, the number 1 indicates a potential production of 1 cubic meter of wood per hectare (14.3 cubic feet per acre) per year, and 10 indicates a potential production of 10 cubic meters of wood per hectare (143 cubic feet per acre) per year. If trees on a soil have a basal area that is typically below what is considered normal, a proportionate reduction was made in determining the first element of the symbol.

The second element of the symbol, a letter, indicates the major kind of soil characteristic that limits tree growth or management. The letter X indicates stoniness or rockiness; W, excessive water, either seasonally or year round, in or on the soil; T, toxic substances within the root zone; D, restricted rooting depth; C, clayey soils; S, sandy soils; F, fragmented or skeletal soils with coarse fragments that are more than 2 millimeters and less than 10 inches in size:, and R, relief or slope. The letter A indicates that no limitations or only slight limitations affect use and management. If a soil has more than one limitation, the letter denoting the most limiting characteristic is used.

In table 9, the soils also are rated for a number of factors to be considered in management. Ratings of *slight, moderate,* and *severe* are used to indicate the degree of major soil limitations. For each moderate or severe rating, a sentence in the applicable soil map unit description explains the soil factor or factors that are the basis of that rating.

Ratings of the *equipment limitation* reflect the soil characteristics and conditions that restrict the use of equipment, either year round or seasonally. A rating of *slight* indicates that the use of equipment is not normally restricted to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation because of soil wetness, a fluctuating water table, or some other factor; and *severe* indicates a seasonal limitation; a need for special equipment, such as that used in one of the cable yarding systems; or a hazard in the use of equipment. Slope and wetness are the main factors that cause equipment limitations. As slope gradient and length increase, using wheeled equipment becomes more difficult. On the steeper slopes, tracked equipment must be used. On the steepest slopes, even tracked equipment cannot be operated safely and more sophisticated systems must be used. Wetness, especially in combination with a fine texture, can severely limit the use of equipment, making harvesting practical only during dry summer months.

Ratings of *seedling mortality* indicate the probability of the death of naturally occurring or planted tree seedlings as influenced by kinds of soil or topographic conditions. Plant competition is not considered in the ratings. The ratings apply to healthy, dormant seedlings from good stock that are properly planted or naturally established seedlings that germinate during a period of insufficient soil moisture. A rating of *slight* indicates that no significant mortality is expected under usual conditions; *moderate* indicates that some mortality can be expected and that extra precautions are advisable; and *severe* indicates that mortality will be high and extra precautions are essential for successful reforestation. Seedling mortality can be caused by wetness; by droughtiness in the surface layer, especially on south- or southwest-facing slopes; or by the position of the soil on a ridgetop. To offset these, larger than usual planting stock, special site preparation, a surface drainage system, or reinforcement planting may be needed.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that trees normally are not blown down by the wind. Strong winds may break the trees but do not uproot them. A rating of *moderate* indicates that an occasional tree may be blown down during periods of excessive wetness and moderate or strong winds, and a rating of *severe* indicates that many trees are expected to be blown down during these periods. A restricted rooting depth caused by a high water table, underlying bedrock, and an impervious layer and poor anchoring of roots because of a loose surface layer and subsoil are responsible for windthrow. Moderate and severe ratings indicate the need for more care in thinning the edges of woodland stands, a plan calling for periodic removal of windthrown trees, and an adequate road and trail system to allow for this removal.

Ratings of *plant competition* indicate the likelihood of the invasion or growth of undesirable brushy plants when openings are made in the tree canopy. A rating of *slight* indicates that unwanted brushy plants are not likely to delay natural reforestation and that planted seedlings can survive and grow well without undue competition; *moderate* indicates that competition will delay natural or artificial reforestation; *severe* indicates that competition can be expected to prevent natural or artificial reforestation. Favorable climate and soil characteristics account for plant competition. In many areas the key to predicating brush competition is the quantity and proximity of seed sources of undesirable plants or the quantity of unwanted bush rootstocks that will resprout after harvest activities. Moderate and severe ratings indicate the need for careful and thorough cleanup after a harvest in preparation for reforestation and the possible need for mechanical or chemical treatment to retard the growth of brush and allow seedlings to become established.

The *potential productivity* of common trees on a soil is expressed as *a site index* and *a productivity class.* The site index is determined by measuring the height and age of selected trees within stands of a given species. It applies to fully stocked, even-aged, unmanaged stands. The highest timber yields, usually expressed in board feet or cubic feet per acre, can be expected from map units with the highest site index values. These values can be converted into estimated yields at various ages by carefully using appropriate yield publications.

The *productivity class,* a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

Common trees are listed in the same order as that of their general occurrence observed on the soil map unit. Generally, only one or two species will predominate.

Trees to plant are those that are planted for reforestation or that, under suitable conditions, are allowed to regenerate naturally. The species listed in table 9 are suited to the soils and can be used for commercial wood production. The desired product, the topographic position, such as a ridgetop, and personal preference are three of many factors that can influence the choice of suitable trees to use for reforestation.

Woodland Understory Vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants. If well managed, some wooded areas can produce enough understory vegetation to support grazing of livestock or wildlife, or both, without damage to the trees.

The quantity and quality of understory vegetation vary with the kind of soil, the age and kind of trees in the canopy, the density of the canopy, and the depth and condition of the litter. The density of the canopy determines the amount of light that understory plants receive.

Table 10 shows, for each soil suitable for commercial woodland, the potential for producing understory vegetation. The *total production* of understory vegetation includes the herbaceous plants and the leaves, twigs, and fruit of woody plants up to a height of 4.5 feet. It is expressed in pounds per acre of air-dry vegetation in favorable, normal, and unfavorable years. In a favorable year, soil moisture is above average during the optimal part of the growing season; in a normal year, soil moisture is average; and in an unfavorable year, it is below average.

Table 10 also lists the common names of the *characteristic vegetation* on each soil and the *composition,* by percentage of air-dry weight, of each kind of plant. The table shows the kind and percentage of understory plants expected under a canopy density that is most nearly typical of woodland in which the production of wood crops is highest.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 11, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties generally are favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 11 can be supplemented by other information in this survey; for example, interpretations for dwellings without basements and for local roads and streets in table 13 and interpretations for septic tank absorption fields in table 14.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes-or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Ivan Lines, biologist, Soil Conservation Service, assisted in writing this section.

Much of this survey area is dominated by cropland and grassland, which are interspersed with patches of shrubs and trees, particularly on moist soils in draws, on steep north-facing slopes, and along streams. Several animals, including mourning dove, chukar, gray partridge, mule deer, coyote, red-tailed hawk, and great horned owl, find their food on the cropland and grassland. All of these species, however, also are highly dependent on a healthy woody plant community for such essentials as browse and thermal, escape, and nesting cover.

The higher elevations in the survey area are dominated by coniferous forests. These areas provide excellent habitat for some wildlife species, such as mule deer, elk, blue and ruffed grouse, Cooper's hawk, goshawk, and numerous song birds and small mammals. During the winter most of the birds migrate to warmer climates to the south or at the lower elevations. Elk and deer also migrate to the lower elevations, where they winter on south-facing slopes, interspersed patches of timber, and wooded draws.

The streams in the survey area, especially the Snake and Grande Ronde Rivers and Asotin Creek, provide habitat for both resident trout and migratory salmon and steelhead. The once abundant numbers of salmon and steelhead have been depleted because of a variety of factors, including dam construction on the Snake River, in-stream sedimentation, and loss of woody riparian vegetation. Control of erosion and sedimentation will contribute to the massive effort presently underway to increase the number of salmon and steelhead.

Soils and climate affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 12, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness. slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are alfalfa, fescue, timothy, alsike clover, crested wheatgrass, and orchardgrass.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluebunch wheatgrass, Idaho fescue, balsamroot, and western yarrow.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are cottonwood, alder, Russian olive, green ash, and black locust.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are ponderosa pine, Douglas spruce, western larch, and grand fir.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountain mahogany, ninebark, serviceberry, snowberry, and rabbitbrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattail, reed canarygrass, rushes, and sedges.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include California quail, pheasant, meadowlark, mourning dove, and cottontail.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants, or both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include ruffed grouse, blue grouse, woodpeckers, squirrels, mule deer, elk, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include mule deer, chukar, meadowlark, and coyote.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses. and the most limiting features are identified. The ratings are given in the following tables: Building Site Development, Sanitary Facilities, Construction Materials, and Water Management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreation uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps and soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 13 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches. and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They. have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills generally are limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 14 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 14 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 14 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage because of rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill-trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 14 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 15 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as *a probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel, or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 15, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the taxonomic unit descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material_

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils generally is preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 16 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even more than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features listed in tables are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 17 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each taxonomic unit under "Taxonomic Units and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added; for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the system adopted by the American Association of State Highway and Transportation Officials (3) and the Unified soil classification system (4). Both systems are described in *PCA Soil Primer (19).*

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification; for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

Rock fragments larger than 10 inches and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 18 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each taxonomic unit under "Soil Series and Their Morphology."

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at '/a bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of the soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low,* a change of less than 3 percent; *moderate, 3* to 6 percent; and *high,* more than 6 percent. *Very high,* more than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (as much as 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion.

Erosion factor T is an estimate of the maximum average rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils generally are not suitable for crops. They are extremely erodible, and vegetation is difficult to establish on them.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy foams, sandy foams, fine sandy foams, and very fine sandy foams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous foams, silt foams, clay foams, and silty clay foams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay foams, and silty clay foams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay foams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous foams and silt foams that are more than 20 percent clay and noncalcareous clay foams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay foams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 18, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Tables 19 and 20 give estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sand or gravelly sand. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay that has high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in swamps and marshes or in closed depressions is considered ponding.

Table 19 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but is possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* (less than 2 days), *brief (2* to 7 days), *long (7* days to 1 month), and *very long* (more than 1 month). Probable dates are expressed in months.

The information on flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons, which are characteristic of soils that are not subject to flooding.

Also considered are local information about the extent and level of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 19 are the depth to the seasonal high water table; the kind of water table-that is, *perched* or *apparent;* and the months of the year that the water table usually is highest. A water table that is seasonally high for less than 1 month is not indicated in the table. Only saturated zones within a depth of about 6 feet are indicated.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower water table by a dry zone.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high, is* based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate, or high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (24). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 21 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in sol. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Xeroll (Xer, meaning dry, plus oll, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploxerolls (Hapl, meaning minimal horizonation, plus xeroll, the suborder of the Mollisols that has a xeric moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective Typic identifies the subgroup that typifies the great group. An example is Typic Haploxerolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle1size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is sandy-skeletal, mixed, mesic Typic Haploxerolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each unit. A pedon, a small three-dimensional area of soil, that is typical of the unit in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (22). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (24). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the unit.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Alpowa Series

The Alpowa series consists of very deep, well drained soils on small benches on canyon walls and foot slopes. These soils formed in loess and in colluvium derived from loess and basalt. Slopes are 15 to 30 percent. Elevation is 800 to 2,600 feet. The

average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 190 days.

These soils are loamy-skeletal, mixed, mesic Calcic Haploxerolls.

Typical pedon of Alpowa stony silt loam, 15 to 30 percent slopes, about 4 miles southwest of Asotin; 600 feet east and 2,000 feet south of the northwest corner of sec. 2, T. 9 N., R. 45 E.

A-0 to 8 inches; dark grayish brown (10YR 4/2) stony silt loam, very dark brown (10YR 2/2) moist; weak medium granular and weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, few fine, and few coarse roots; many irregular pores; about 15 percent pebbles, 5 percent cobbles, and 2 percent stones; mildly alkaline; clear wavy boundary.

BA-8 to 12 inches; brown (10YR 5/3) very cobble silt loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, few fine, and few coarse roots; many irregular pores; about 10 percent pebbles, 25 percent cobbles, and 5 percent stones; mildly alkaline; clear wavy boundary.

Bw-12 to 23 inches; brown (10YR 5/3) *very* cobbly silt loam, dark brown (10YR 3/3) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine, few fine, and few medium roots; common irregular pores; about 10 percent pebbles, 25 percent cobbles, and 5 percent stones; mildly alkaline; clear wavy boundary.

Bk1-23 to 30 inches; light gray (10YR 7/2) very cobbly loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine, few fine, and few medium roots; common irregular and common tubular pores; many coatings of secondary lime in seams and pores and many coatings on the underside of basalt fragments; about 15 percent pebbles, 30 percent cobbles, and 5 percent stones; violently effervescent; strongly alkaline; clear wavy boundary.

Bk2-30 to 60 inches; pale brown (10YR 6/3) very cobbly loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common irregular pores; common coatings of lime on the underside of basalt fragments and few fine spheroidal aggregates of lime; about 15 percent pebbles, 30 percent cobbles, and 5 percent stones; violently effervescent; strongly alkaline.

The depth to lime ranges from 12 to 30 inches. The mollic epipedon is 10 to 14 inches thick.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. The BA and Bw horizons have value of 5 or 6 when dry and 3 or 4 when moist. They are very gravelly silt loam, very cobbly silt loam, very gravelly loam, or very cobbly loam. They are mildly alkaline or moderately alkaline. The Bk horizon has value of 6 or 7 when dry and chroma of 2 or 3 when dry and moist. It is very cobbly or very gravelly loam. It is moderately alkaline or strongly alkaline.

Alpowa Variant

The Alpowa Variant consists of moderately deep, well drained soils on plateaus. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 8 percent. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 125 to 135 days.

These soils are loamy-skeletal, mixed, mesic Calcic Argixerolls.

Typical pedon of Alpowa Variant silt loam, 3 to 8 percent slopes, about 16 miles west of Asotin; 1,600 feet south and 2.600 feet west of the northeast corner of sec. 27, T. 10 N., R. 43 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; about 5 percent pebbles and 5 percent cobbles; neutral; abrupt smooth boundary.

AB-7 to 10 inches; dark grayish brown (10YR 4/2) gravelly silty clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; many very fine irregular and tubular pores; about 20 percent pebbles and 5 percent cobbles; neutral; clear wavy boundary.

Bt-10 to 14 inches; grayish brown (10YR 5/2) very cobbly silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine irregular and tubular pores; many thin stress cutans and clay films on faces of peds; about 25 percent pebbles and 25 percent cobbles; neutral; clear wavy boundary.

Btk-14 to 22 inches; white (10YR 8/2) very cobbly clay loam, grayish brown (10YR 5/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine irregular and tubular pores; many thin stress cutans and clay films on faces of peds; continuous coatings of lime on the underside of basalt fragments; about 20 percent pebbles and 25 percent cobbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2R-22 inches; basalt.

The depth to lime ranges from 12 to 20 inches. The depth to lithic contact with basalt ranges from 20 to 30 inches. The mollic epipedon is 12 to 20 inches thick.

The AB horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is silty clay loam, silt loam, gravelly silt loam, or gravelly silty clay loam.

The Bt horizon has chroma of 2 or 3 when dry and moist. It is gravelly silt loam, very cobbly silty clay loam, or very gravelly silt loam. It is neutral or mildly alkaline.

The Btk horizon has value of 5 to 8 when dry and 4 to 6 when moist and chroma of 1 to 3 when dry and moist. It is very gravelly clay loam, very cobbly loam, extremely cobbly loam, or very cobbly clay loam. It is moderately alkaline or strongly alkaline.

Asotin Series

The Asotin series consists of moderately deep, well drained soils on north-facing canyon walls. These soils formed in loess, colluvium, and slope alluvium derived from weathered basalt. Slopes are 40 to 90 percent. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 190 days.

These soils are coarse-loamy, mixed, mesic Calcic Haploxerolls.

Typical pedon of Asotin silt loam, in an area of Bolicker-Asotin silt loams, 40 to 90 percent slopes, about 8 miles west of Clarkston; 900 feet north and 2,600 feet east of the southwest corner of sec. 25, T. 11 N., R. 44 E.

A-0 to 4 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium and coarse granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; mildly alkaline; clear wavy boundary.

AB-4 to 11 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular and common very fine tubular pores; mildly alkaline; clear wavy boundary.

Bw-11 to 19 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium and coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular and common very fine tubular pores; about 5 percent pebbles; mildly alkaline; clear wavy boundary.

Bk-19 to 23 inches; very pale brown (10YR 7/3) gravelly silt loam, brown (10YR 5/3) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine roots; few very fine irregular pores; many coatings of lime in seams and pores and many coatings on the underside of basalt fragments; about 30 percent pebbles; violently effervescent; strongly alkaline; abrupt irregular boundary.

2R-23 inches; basalt.

The depth to lime ranges from 15 to 35 inches. The depth to lithic contact with basalt ranges from 20 to 40 inches. The mollic epipedon is 10 to 16 inches thick.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. The Bw horizon has value of 3 or 4 when moist and chroma of 3 or 4 when dry and moist. It is mildly alkaline or moderately alkaline. The Bk horizon has value of 6 or 7 when dry and chroma of 2 or 3 when dry and moist. It is moderately alkaline or strongly alkaline.

Bolicker Series

The Bolicker series consists of very deep, well drained soils on north-facing canyon walls, slump blocks, and foot slopes. These soils formed in loess and in the underlying basaltic colluvium. Slopes are 15 to 90 percent. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 190 days.

These soils are coarse-loamy, mixed, mesic Calcic Haploxerolls.

Typical pedon of Bolicker silt loam, in an area of Bolicker-Asotin silt loams, 40 to 90 percent slopes, about 8 miles west of Clarkston; 900 feet north and 2,000 feet east of the southwest corner of sec. 25, T. 11 N., R. 44 E.

A1-0 to 4 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium and coarse granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; mildly alkaline; clear wavy boundary.

A2-4 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular and few very fine tubular pores; mildly alkaline; clear wavy boundary.

Bw-11 to 29 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular and few very fine tubular pores; about 5 percent pebbles; mildly alkaline; clear wavy boundary.

2Bk-29 to 60 inches; very pale brown (10YR 7/3) very cobbly loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine irregular and common very fine tubular pores; common fine spheroidal aggregates of lime; common coatings of secondary lime in pores and many coatings on the underside of basalt fragments; about 30 percent pebbles and 20 percent cobbles; violently effervescent; strongly alkaline.

The depth to lime ranges from 25 to 43 inches. The mollic epipedon is 8 to 18 inches thick.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. The Bw horizon has value of 3 or 4 when moist and chroma of 3 or 4 when dry and moist. The 2Bk horizon has value of 6 or 7 when dry and chroma of 2 or 3 when dry and moist. It is very cobbly, very gravelly, or cobbly loam. It is moderately alkaline or strongly alkaline.

Bridgewater Series

The Bridgewater series consists of very deep, well drained soils that formed in alluvium on flood plains, low terraces, and alluvial fans. Slopes are 0 to 15 percent. Elevation is 800 to 2,500 feet. The average annual precipitation is 12 to 19 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 120 to 150 days.

These soils are loamy-skeletal, mixed, mesic Cumulic Haploxerolls.

Typical pedon of Bridgewater extremely stony sandy loam, 0 to 15 percent slopes, about 9 miles southwest of Anatone; 1,200 feet south and 2,300 feet west of the northeast corner of sec. 5, T. 6 N., R. 44 E.

A1-0 to 8 inches; dark grayish brown (10YR 4/2) extremely stony sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine irregular pores; about 30 percent pebbles, 25 percent cobbles, and 15 percent stones; neutral; clear wavy boundary.

A2-8 to 30 inches; dark grayish brown (10YR 4/2) extremely cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine irregular pores; about 30 percent pebbles, 30 percent cobbles, and 10 percent stones; neutral; clear wavy boundary.

2C-30 to 60 inches; brown (10YR 5/3) extremely cobbly loamy sand, very dark grayish brown (10YR 3/2) moist; single grained; loose; few very fine roots; about 30 percent pebbles, 30 percent cobbles, and 10 percent stones; neutral.

Depth to the 2C horizon ranges from 20 to 40 inches. The mollic epipedon is 20 to 40 inches thick. Reaction is neutral or slightly acid throughout the profile.

The A1 horizon has value of 3 or 4 when dry and chroma of 1 or 2 when moist. The A2 horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It is extremely cobbly sandy loam, extremely cobbly loam, or extremely cobbly coarse sandy loam.

The 2C horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 1 to 3 when dry and moist. It is extremely cobbly coarse sand, extremely cobbly loamy sand, or extremely cobbly sand.

Bridgewater Variant

The Bridgewater Variant consists of very deep, moderately well drained soils on flood plains. These soils formed in alluvium. Slopes are 0 to 8 percent. Elevation is 1,500 to 3,000 feet. The average annual precipitation is 19 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

These soils are loamy-skeletal, mixed, frigid Cumulic Haploxerolls.

Typical pedon of Bridgewater Variant stony loam, 0 to 8 percent slopes, about 5 miles west of Cloverland; 800 feet east and 3,400 feet north of the southwest corner of sec. 19, T. 9 N., R. 44 E.

A1-0 to 8 inches; dark gray (10YR 4/1) stony loam, black (10YR 2/1) moist; weak fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; about 20 percent pebbles, 5 percent cobbles, and 2 percent stones; neutral; clear wavy boundary.

A2-8 to 14 inches; dark grayish brown (10YR 4/2) extremely cobbly loam, very dark brown (10YR 2/2) moist; weak fine and medium granular and weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; about 25 percent pebbles, 40 percent cobbles, and 10 percent stones; neutral; clear wavy boundary.

A3-14 to 38 inches; grayish brown (10YR 5/2) extremely cobbly loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; about 25 percent pebbles, 40 percent cobbles, and 5 percent stones; neutral; clear wavy boundary.

2C-38 to 60 inches; grayish brown (10YR 5/2) extremely cobbly loamy coarse sand, very dark grayish brown (10YR 3/2) moist; single grained; loose; few very fine roots; common mottles; about 25 percent pebbles, 40 percent cobbles, and 5 percent stones; neutral.

Depth to the 2C horizon ranges from 20 to 40 inches. The mollic epipedon is 20 to 40 inches thick. Reaction is neutral or slightly acid throughout the profile.

The A1 horizon has value of 3 or 4 when dry and chroma of 1 or 2 when moist. The A2 and A3 horizons have value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. They are extremely cobbly sandy loam or extremely cobbly coarse sandy loam.

The 2C horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 1 to 3 when dry and moist. It is extremely cobbly coarse sand, extremely cobbly loamy coarse sand, or extremely cobbly sand.

Catheen Series

The Catheen series consists of very deep, well drained soils on plateaus and hillslopes. These soils formed in loess. Slopes are 3 to 30 percent. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

These soils are fine-silty, mixed, mesic Calcic Pachic Argixerolls.

Typical pedon of Catheen silt loam, in an area of Spofmore-Catheen silt loams, 3 to 8 percent slopes, 5 miles northeast of Anatone; 20 feet south and 1,400 feet west of the northeast corner of sec. 10, T. 8 N., R. 46 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium and coarse granular structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; neutral; abrupt smooth boundary.

A-7 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium and coarse subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many *very* fine irregular pores; mildly alkaline; clear wavy boundary.

Bt-13 to 25 inches; brown (10YR 5/3) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm, sticky and plastic; many very fine roots; many very fine irregular and very fine tubular pores; many thin stress cutans and clay films on faces of peds and few thin clay films lining pores; mildly alkaline; clear wavy boundary.

Btk1-25 to 42 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure; hard, firm, sticky and plastic; common very fine roots; common very fine irregular pores; many thin stress cutans and clay films on faces of peds; many coatings of lime on faces of peds and lining pores; violently effervescent; moderately alkaline; clear wavy boundary.

Btk2-42 to 49 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure; hard, firm, sticky and plastic; common very fine roots; common very fine irregular pores; many thin stress cutans and clay films on faces of peds; common coatings of lime on faces of peds and lining pores; strongly effervescent; moderately alkaline; clear wavy boundary.

Btk3-49 to 60 inches; brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; strong medium angular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; common very fine irregular pores; continuous moderately thick stress cutans and clay films on faces of peds; few coatings of lime lining pores; slightly effervescent; moderately alkaline.

The depth to lime ranges from 20 to 44 inches. The argillic horizon is more than 20 inches thick. The mollic epipedon is 20 to 34 inches thick.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is neutral or mildly alkaline.

The Bt horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It is silty clay loam or silt loam. It is neutral or mildly alkaline.

The Btk horizon has value of 5 to 7 when dry and 3 to 6 when moist and chroma of 2 to 4 when dry and moist. It is silty clay loam or silt loam. Some pedons have a Bk horizon rather than a Btk horizon. Reaction generally is moderately alkaline in the Btk horizon and ranges to strongly alkaline in the Bk horizon.

Chard Series

The Chard series consists of very deep, well drained soils on terraces and terrace escarpments. These soils formed in loess and glaciofluvial deposits. Slopes are 2 to 60 percent. Elevation is 800 to 1,300 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

These soils are coarse-loamy, mixed, mesic Calcic Haploxerolls.

Typical pedon of Chard loam, 2 to 5 percent slopes, about 0.5 mile west of Clarkston; 2,200 feet south and 2,400 feet east of the northwest corner of sec. 30, T. 11 N., R. 46 E.

Ap-0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; neutral; abrupt smooth boundary.

AB1-8 to 13 inches; brown (10YR 5/3) loam, *very* dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; mildly alkaline; clear wavy boundary.

AB2-13 to 18 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine irregular and common very fine tubular pores; mildly alkaline; clear wavy boundary.

Bw-18 to 31 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular and few very fine irregular pores; mildly alkaline; clear wavy boundary.

2Bk1-31 to 36 inches; light brownish gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine roots; common very fine irregular and few very fine tubular pores; many irregular coarse masses of lime; violently effervescent; strongly alkaline; clear wavy boundary.

2Bk2-36 to 60 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; common irregular pores; few fine spheroidal aggregates of lime; violently effervescent; strongly alkaline.

The depth to lime ranges from 20 to 35 inches. The mollic epipedon is 8 to 20 inches thick.

The AB horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry. It is neutral or mildly alkaline.

The Bw horizon has chroma of 2 or 3 when moist. It is mildly alkaline or moderately alkaline. The 2Bk horizon has value of 4 to 7 when dry and 3 to 5 when moist and chroma of 2 or 3 when dry and moist. It is moderately alkaline or strongly alkaline.

Cloverland Series

The Cloverland series consists of deep and very deep, moderately well drained soils on mountain plateaus, benches, and north-facing hillslopes. These soils formed in loess that has minor amounts of slope alluvium, material weathered from basalt, and volcanic ash. Slopes are 3 to 45 percent. Elevation is 3,200 to 4,400 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

These soils are fine-silty, mixed, frigid Xeric Argialbolls.

Typical pedon of Cloverland silt loam, very deep, 3 to 8 percent slopes, about 20 miles southwest of Anatone; 400 feet west and 1.000 feet north of the southeast corner of sec. 4, T. 6 N., R. 42 E.

Oi&Oe-2 inches to 0; loose, partly decomposed needles and twigs.

A-0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, black (10YR 2/1) moist; moderate medium granular structure; hard, firm, sticky and plastic; many very fine, fine, medium, and coarse roots; many very fine irregular and few fine tubular pores; slightly acid; clear wavy boundary.

AB-6 to 10 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine, fine, medium, and coarse roots; many very fine irregular and few fine tubular pores; slightly acid; clear wavy boundary.

Bt1-10 to 21 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine, fine, and medium and few coarse roots; many very fine irregular and few fine tubular pores; few thin stress cutans and clay films on faces of peds; slightly acid; clear wavy boundary.

Bt2-21 to 30 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine, fine, and medium roots; common very fine irregular and few fine tubular pores; continuous thin stress cutans and clay films on faces of peds; neutral; clear wavy boundary.

B/Eb-30 to 37 inches; about 60 percent brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common very fine, fine, and medium roots; common very fine irregular pores; few thin stress cutans and clay films on faces of some peds; about 40 percent light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; common very fine irregular pores; medium acid; clear irregular boundary.

Btb1-37 to 40 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; common medium light brownish gray (10YR 6/2) bleached spots; strong medium angular blocky structure; very hard, firm, sticky and plastic; few very fine and fine roots; common very fine irregular pores; continuous thick dark brown (10YR 3/3) stress cutans and clay films on faces of peds; neutral; clear wavy boundary.

Btb2-40 to 60 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; strong medium and coarse angular blocky structure; very hard, firm, sticky and plastic; few very fine and fine roots; common very fine irregular pores; continuous thick very dark brown (10YR 2/2) and brown (10YR 5/3) stress cutans and clay films on faces of peds; common very fine iron and manganese concretions; about 5 percent weathered basalt pebbles; neutral.

The thickness of the solum and the depth to lithic contact with basalt range from 40 to more than 60 inches. Depth to the buried soil ranges from 25 to 40 inches. The mollic epipedon is 20 to 35 inches thick.

The A or Ap horizon has value of 3 or 4 when dry and 2 or 3 when moist and chroma of 1 or 2 when moist. It is medium acid or slightly acid. The AB horizon also is medium acid or slightly acid. It has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist.

The Bt horizon has value of 4 or 5 when dry and chroma of 2 or 3 when dry and moist. It is silt loam or silty clay loam. It is medium acid or slightly acid.

The B part of the B/E horizon has value of 4 or 5 when dry and chroma of 2 or 3 when dry and moist. It is silt loam or silty clay loam. The E part has value of 5 or 6 when dry and 3 or 4 when moist and chroma of 2 or 3 when moist. This horizon is medium acid or slightly acid.

The Btb horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry and moist. The upper part of this horizon is silty clay loam or silty clay. The lower part is dominantly silty clay loam, clay loam, or clay. It is gravelly silty clay loam, very gravelly clay, or very cobbly clay loam, however, in pedons that have bedrock within a depth of 60 inches. This horizon is slightly acid or neutral.

Crackercreek Series

The Crackercreek series consists of deep, well drained soils on north-facing mountainsides and canyon walls. These soils formed in a mantle of volcanic ash and in the underlying colluvium derived from weathered basalt. Slopes are 30 to 60 percent. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

These soils are loamy-skeletal, mixed, Mollic Eutroboralfs.

Typical pedon of Crackercreek stony silt loam, 30 to 60 percent slopes, about 5 miles west of Anatone; 2,200 feet south and 2,600 feet east of the northwest corner of sec. 1, T. 7 N., R. 44 E.

Oi&Oe-1 inch to 0; needles, twigs, moss, and partially decomposed litter.

A-0 to 2 inches; brown (10YR 5/3) stony silt loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; common very fine and fine roots; common very fine and fine irregular pores; about 5 percent pebbles and 2 percent stones; slightly acid; clear wavy boundary.

Bw-2 to 15 inches; yellowish brown (10YR 5/4) stony silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine, common medium, and few coarse roots; common very fine irregular and few fine tubular pores; about 10 percent pebbles, 5 percent cobbles, and 5 percent stones; medium acid; clear wavy boundary.

2Btb1-15 to 20 inches; yellowish brown (10YR 5/4) very gravelly loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine, fine, medium, and coarse roots; common very fine irregular and common fine tubular pores; continuous thin stress cutans and clay films on faces of peds; about 20 percent pebbles, 15 percent cobbles, and 5 percent stones; medium acid; clear wavy boundary.

2Btb2-20 to 26 inches; yellowish brown (10YR 5/4) very cobbly clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine, fine, medium, and coarse roots; common very fine and fine tubular pores; continuous thin stress cutans and clay films on faces of peds; about 20 percent pebbles, 30 percent cobbles, and 10 percent stones; medium acid; clear irregular boundary.

2Btb3-26 to 51 inches; yellowish brown (10YR 5/4) extremely cobbly loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, sticky and plastic; common very fine and fine and few medium roots; few very fine irregular pores; few thin stress cutans and clay films on faces of peds; about 25 percent pebbles, 40 percent cobbles, and 10 percent stones; medium acid; abrupt irregular boundary.

3R-51 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 40 to 60 inches. The mantle of volcanic ash is 14 to 20 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and moist. It is medium acid or slightly acid.

The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry and moist. It is stony, cobbly, or gravelly silt loam. It is medium acid or slightly acid.

The 2Btb horizon has hue of 5YR to 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry and moist. It is very gravelly loam, loam, very cobbly clay loam, very cobbly loam, extremely cobbly loam, or very gravelly clay loam. It is medium acid to neutral.

Dallesport Series

The Dallesport series consists of very deep, somewhat excessively drained soils on terraces and terrace escarpments. These soils formed in sandy and gravelly old alluvium that has minor amounts of eolian material in the upper part. Slopes are 3 to 60 percent. Elevation is 750 to 1,200 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

These soils are sandy-skeletal, mixed, mesic Typic Haploxerolls.

Typical pedon of Dallesport very cobbly sandy loam, 30 to 60 percent slopes, about 1 mile west of Clarkston; 400 feet south and 2,000 feet west of the northeast corner of sec. 25, T. 11 N., R. 45 E.

A-0 to 5 inches; dark grayish brown (10YR 4/2) very cobbly sandy loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 15 percent pebbles and 25 percent cobbles; neutral; clear wavy boundary.

Bw-5 to 13 inches; brown (10YR 4/3) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many irregular pores; about 40 percent pebbles and 5 percent cobbles; neutral; clear wavy boundary.

2C1-13 to 23 inches; brown (10YR 5/3) very gravelly sand, dark grayish brown (10YR 4/2) moist; single grained; loose; many very fine roots; about 40 percent pebbles and 10 percent cobbles; neutral; clear wavy boundary.

2C2-23 to 50 inches; light brownish gray (10YR 6/2) very gravelly sand, grayish brown (10YR 5/2) moist; single grained; loose; common *very* fine roots; about 45 percent pebbles and 10 percent cobbles; neutral; clear wavy boundary.

2Ck-50 to 60 inches; light brownish gray (10YR 6/2) extremely gravelly sand, grayish brown (10YR 5/2) moist; single grained; loose; few very fine roots; discontinuous lenses that are weakly cemented with secondary lime; about 50 percent pebbles and 20 percent cobbles; violently effervescent; moderately alkaline.

The depth to lime ranges from 44 to 60 inches. The mollic epipedon is 10 to 16 inches thick.

The Bw horizon has value of 4 to 6 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It is neutral or mildly alkaline.

The 2C horizon has value of 5 or 6 when dry and 4 or 5 when moist and chroma of 1 to 3 when dry and moist. It is very gravelly, very cobbly, or extremely gravelly sand. It is neutral or mildly alkaline.

The 2Ck horizon has value of 6 to 8 when dry and 5 to 7 when moist and chroma of 1 to 3 when dry and moist. It is extremely gravelly, extremely cobbly, or very gravelly sand.

DeMasters Series

The DeMasters series consists of deep, well drained soils on north-facing canyon walls and foot slopes. These soils formed in colluvium derived from weathered basalt and in loess and some volcanic ash. Slopes are 8 to 90 percent. Elevation is 3,000 to 4,500 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 90 to 110 days.

These soils are fine-loamy, mixed, frigid Pachic Ultic Argixerolls.

Typical pedon of DeMasters silt loam, in an area of the Snell-Harlow-DeMasters complex, 60 to 90 percent slopes, about 8 miles southeast of Anatone; 1,100 feet south and 1,200 feet west of the northeast corner of sec. 12, T. 6 N., R. 46 E.

A1-0 to 9 inches; black (10YR 2/1) silt loam, black (10YR 2/1) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine and common medium roots; common very fine and fine tubular pores; about 5 percent pebbles; neutral; clear wavy boundary.

A2-9 to 16 inches; very dark grayish brown (10YR 3/2) silt loam, black (10YR 2/1) moist; moderate medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine and common medium roots; common very fine and fine tubular pores; about 10 percent pebbles; neutral; clear wavy boundary.

A3-16 to 24 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse prismatic and moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine and few medium roots; very fine and fine tubular pores; about 10 percent pebbles; neutral; clear wavy boundary.

2BAt-24 to 33 inches; dark brown (10YR 3/3) cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine and few medium roots; common very fine tubular pores; common thin stress cutans and clay films on faces of peds; about 10 percent pebbles and 10 percent cobbles; neutral; clear wavy boundary.

2Bt-33 to 44 inches; brown (10YR 4/3) very cobbly loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; common very fine and fine roots; common very fine tubular pores; common thin stress cutans and clay films on faces of peds; about 20 percent pebbles and 25 percent cobbles; neutral; abrupt wavy boundary.

3R-44 inches; basalt.

The depth to lithic contact with basalt ranges from 40 to 60 inches. The mollic epipedon is 30 to 40 inches thick. Reaction is medium acid to neutral throughout the profile.

The A horizon has value of 2 to 4 when dry and 1 or 2 when moist and chroma of 1 or 2 when dry and moist. The A2 and A3 horizons are silt loam or loam.

The BAt horizon has value of 3 or 4 when dry and 2 or 3 when moist and chroma of 2 or 3 when moist. It is cobbly loam, clay loam, gravelly silty clay loam, cobbly clay loam, or gravelly loam. The Bt horizon has value of 4 or 5 when dry. It is very cobbly loam, very cobbly clay loam, or very gravelly loam.

Ewall Series

The Ewall series consists of very deep, excessively drained soils on terraces. These soils formed in sandy eolian and glaciofluvial material. Slopes are 2 to 10 percent. Elevation is 750 to 850 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

These soils are mixed, mesic Typic Xeropsamments.

Typical pedon of Ewall loamy fine sand, 2 to 10 percent slopes, about 4 miles south of Asotin; 1,400 feet north and 2,400 feet east of the southwest corner of sec. 12, T. 9 N., R. 46 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark brown (10YR 2/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; neutral; abrupt wavy boundary.

A-7 to 13 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots; mildly alkaline; clear wavy boundary.

AC-13 to 18 inches; brown (10YR 5/3) sand, very dark grayish brown (10YR 3/2) moist; single grained; loose; many very fine roots; mildly alkaline; clear wavy boundary.

C1-18 to 29 inches; grayish brown (10YR 5/2) sand, dark grayish brown (10YR 4/2) moist; single grained; loose; many very fine roots; strongly effervescent; mildly alkaline; clear wavy boundary.

C2-29 to 43 inches; light brownish gray (10YR 6/2) sand, dark grayish brown (10YR 4/2) moist; single grained; loose; common very fine roots; strongly effervescent; mildly alkaline; clear wavy boundary.

C3-43 to 60 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grained; loose; few very fine roots; strongly effervescent; mildly alkaline.

The depth to lime ranges from 25 to more than 60 inches. The A and AC horizons are neutral or mildly alkaline. The A horizon has value of 4 or 5 when dry and chroma of 2 or 3 when dry and moist, and the AC horizon has chroma of 2 or 3 when moist. The dark colors are inherited from the basalt. The content of organic matter in these horizons is less than 1 percent. The C horizon has value of 4 or 5 when moist and chroma of 2 or 3 when dry and moist.

Ferdinand Series

The Ferdinand series consists of moderately deep, well drained soils on plateaus. These soils formed in loess and in material weathered from basalt. Slopes are 3 to 8 percent. Elevation is 3,000 to 3,600 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 130 days.

These soils are clayey-skeletal, montmorillonitic, mesic Calcic Argixerolls.

Typical pedon of Ferdinand silty clay loam, 3 to 8 percent slopes, about 4 miles northwest of Anatone; 500 feet north and 700 feet west of the southeast corner of sec. 7, T. 8 N., R. 45 E.

Ap-0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate medium and coarse granular structure; hard, firm, sticky and plastic; many very fine roots; common very fine irregular pores; about 5 percent pebbles and 5 percent cobbles; neutral; abrupt smooth boundary.

2BAt-7 to 11 inches; dark grayish brown (10YR 4/2) very gravelly silty clay loam, very dark grayish brown (10YR 3/2) moist; common medium coatings on faces of peds, very dark brown (10YR 2/2) moist; strong medium subangular blocky structure; very hard, firm, sticky and plastic; common very fine roots; common very fine irregular pores; continuous thick stress cutans and clay films on faces of peds; about 40 percent pebbles and 10 percent cobbles; neutral; clear wavy boundary.

2Bt-11 to 16 inches; dark yellowish brown (10YR 3/4) very gravelly silty clay, dark brown (7.5YR 3/2) moist; strong medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; continuous thick stress cutans and clay films on faces of peds; about 30 percent pebbles and 10 percent cobbles; neutral; clear wavy boundary.

2Btk-16 to 23 inches; brown (10YR 5/3) very cobbly clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine irregular and tubular pores; common thin stress cutans and clay films on faces of peds; common irregular coarse very pale brown (10YR 8/3) masses of lime and many fine spheroidal aggregates of lime; about 25 percent pebbles and 30 percent cobbles; strongly effervescent; moderately alkaline; abrupt irregular boundary.

3R-23 inches; basalt.

The depth to lime ranges from 15 to 20 inches. The depth to lithic contact with basalt ranges from 20 to 30 inches. The mollic epipedon is 15 to 20 inches thick.

The Ap horizon has value of 3 or 4 when dry and chroma of 1 or 2 when dry and moist. It is slightly acid or neutral.

The BAt horizon has hue of 7.5YR or 10YR and value of 3 or 4 when dry. It is cobbly silty clay loam, very gravelly silty clay loam, or very cobbly clay loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 3 to 5 when dry, and chroma of 2 to 4 when dry and moist. It is cobbly silty clay, very gravelly silty clay loam, or very cobbly clay. It is neutral or mildly alkaline.

The 2Btk horizon has value of 5 to 7 when dry and 4 or 5 when moist and chroma of 2 to 4 when dry and moist. It is very cobbly or very gravelly clay loam. It is mildly alkaline to strongly alkaline.

Ferdinand Variant

Ferdinand Variant consists of very deep, well drained soils on terraces. These soils formed in old alluvium that has minor amounts of loess in the upper part. Slopes are 8 to 40 percent. Elevation is 1,800 to 3,000 feet. The average annual precipitation is 16 or 17 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 135 days.

These soils are clayey-skeletal, montmorillonitic, mesic Typic Argixerolls.

Typical pedon of Ferdinand Variant, in an area of the Ferdinand Variant-Mallory Variant association, 8 to 70 percent slopes, about 2 miles south of Rogersburg; 300 feet east and 1,200 feet north of the southwest corner of sec. 30, T. 7 N., R. 47 E.

Ap-0 to 5 inches; brown (7.5YR 4/2) very cobbly clay loam, dark brown (7.5YR 3/2) moist; moderate fine, medium, and coarse granular structure; hard, firm, sticky and plastic; many very fine roots; many very fine irregular pores; about 15 percent pebbles and 25 percent cobbles; clear wavy boundary.

Bt1-5 to 14 inches; reddish brown (5YR 4/3) very gravelly clay, dark reddish brown (5YR 3/3) moist; strong fine subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; continuous thick stress cutans and clay films on faces of peds; common very fine irregular pores; about 35 percent pebbles and 15 percent cobbles; neutral; clear wavy boundary.

Bt2-14 to 23 inches; reddish brown (5YR 4/4) very gravelly clay, reddish brown (5YR 4/3) moist; strong fine and medium subangular blocky structure; very hard, very firm, sticky and plastic; common very fine roots; continuous thick stress cutans and clay films on faces of peds; common very fine tubular and irregular pores; about 35 percent pebbles and 15 percent cobbles; neutral; clear wavy boundary.

Btk-23 to 60 inches; reddish brown (5YR 4/4) very cobbly clay, reddish brown (5YR 4/3) moist; strong fine and medium subangular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; continuous thick stress cutans and clay films on faces of peds; common coatings of lime on faces of peds; common very fine tubular and irregular pores; about 20 percent pebbles, 35 percent cobbles, and 5 percent stones; mildly alkaline.

The depth to lime ranges from 20 to 40 inches. The mollic epipedon is 8 to 20 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry, and chroma of 1 or 2 when dry and moist. The Bt horizon has hue of 7.5YR or 5YR, value of 3 or 4 when moist, and chroma of 2 to 4 when dry and moist. It is very gravelly clay, very cobbly clay, or very cobbly clay loam. The Btk horizon has value of 4 or 5 when dry and chroma of 3 or 4 when dry and moist. It is very cobbly clay, extremely cobbly clay, or very gravelly clay loam. It is mildly alkaline or moderately alkaline.

Geoconda Series

The Geoconda series consists of deep, well drained soils on plateaus and hillslopes. These soils formed in loess, slope alluvium, and material weathered from basalt. Slopes are 3 to 30 percent. Elevation is 3,000 to 3,600 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 130 days.

These soils are fine, montmorillonitic, mesic Calcic Pachic Argixerolls.

Typical pedon of Geoconda silty clay loam, in an ,area of the Geoconda-Powwahkee complex, 3 to 6 percent slopes, about 2 miles northeast of Anatone; 1,000 feet south and 2,600 feet west of the northeast corner of sec. 19, T. 8 N., R. 46 E.

Ap-0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate fine, medium, and coarse granular structure; hard, firm, sticky and plastic; many very fine roots; common very fine irregular pores; neutral; abrupt smooth boundary.

A-7 to 11 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; many very fine irregular pores; neutral; clear wavy boundary.

BAt-11 to 19 inches; very dark gray (10YR 3/1) silty clay, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; continuous thick stress cutans and clay films on faces of peds and lining pores; mildly alkaline; clear wavy boundary.

Bt-19 to 25 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; continuous thick stress cutans and clay films on faces of peds and clay films lining some pores; mildly alkaline; clear wavy boundary.

Btk1-25 to 54 inches; brown (10YR 5/3) silty clay, dark brown (10YR 3/3) moist; moderate medium and coarse subangular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine roots; common very fine irregular pores; continuous moderately thick stress cutans and clay films on faces of peds and clay films lining some pores; common coatings of lime in pores and on faces of peds; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2Btk2-54 to 57 inches; brown (10YR 5/3) gravelly silty clay, dark brown (10YR 3/3) moist; moderate medium and coarse subangular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine roots; common very fine irregular pores; continuous moderately thick stress cutans and clay films on faces of peds and common thin clay films lining pores; common coatings of lime in pores and on faces of peds; about 25 percent pebbles and 5 percent cobbles; moderately alkaline; abrupt irregular boundary.

3R-57 inches; basalt.

The depth to lime ranges from 20 to 38 inches. The depth to lithic contact with basalt ranges from 40 to more than 60 inches. The mollic epipedon is 20 to 38 inches thick and includes part of the argillic horizon.

The Ap and A horizons have value of 3 or 4 when dry and chroma of 1 or 2 when dry and moist. They are slightly acid or neutral.

The BAt horizon has hue of 7.5YR or 10YR and value of 3 or 4 when dry and 2 or 3 when moist. It is neutral or mildly alkaline.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 to 4 when dry and moist. It is neutral or mildly alkaline.

The Btk horizon has value of 5 to 7 when dry and 3 to 5 when moist and chroma of 2 or 3 when dry and moist. It is silty clay, gravelly silty clay, very cobbly clay loam, very gravelly clay loam, gravelly loam, or very gravelly loam. It is moderately alkaline or strongly alkaline. Some pedons have a thin Bk horizon directly above the fractured basalt.

Getaway Series

The Getaway series consists of deep, well drained soils on mountainsides and canyon walls. These soils formed in loess, in some volcanic ash, and in colluvium and slope alluvium derived from weathered basalt. Slopes are 30 to 90 percent. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

These soils are loamy-skeletal, mixed, frigid Pachic Ultic Argixerolls.

Typical pedon of Getaway stony silt loam, in an area of the Getaway-Snell complex, 30 to 70 percent slopes, about 4 miles west of Anatone; 350 feet south and 1,600 feet west of the northeast corner of sec. 19, T. 8 N., R. 45 E.

Oi&Oe-1 inch to 0; loose, partly decayed needles, twigs, and branches.

A1-0 to 4 inches; dark grayish brown (10YR 4/2) stony silt loam, very dark brown (10YR 2/2) moist; weak medium and coarse granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine and few medium roots; many very fine irregular pores; about 15 percent pebbles, 10 percent cobbles, and 2 percent stones; neutral; clear smooth boundary.

A2-4 to 15 inches; dark grayish brown (10YR 4/2) very cobbly silt loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky and weak medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine and few medium roots; many very fine irregular pores; about 15 percent pebbles, 20 percent cobbles, and 5 percent stones; slightly acid; clear smooth boundary.

2BAt-15 to 30 inches; brown (10YR 4/3) very cobbly silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; few very fine, common very fine, fine, and medium, and few coarse roots; common very fine irregular pores; few thin stress cutans and clay films on faces of peds; about 10 percent pebbles, 25 percent cobbles, and 5 percent stones; slightly acid; clear wavy boundary.

2Bt1-30 to 43 inches; yellowish brown (10YR 5/4) very cobbly clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; common very fine, fine, and medium and few coarse roots; common very fine irregular and few fine tubular pores; many thin stress cutans and clay films on faces of peds; about 10 percent pebbles, 25 percent cobbles, and 2 percent stones; neutral; clear wavy boundary.

2Bt2-43 to 58 inches; yellowish brown (10YR 5/4) very cobbly clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; very hard, firm, very sticky and very plastic; common fine and few very fine and coarse roots; common very fine irregular pores and few fine tubular pores; continuous moderately thick stress cutans and clay films on faces of peds; about 20 percent pebbles and 30 percent cobbles; neutral (pH 6.8); abrupt wavy boundary.

3R-58 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 40 to 60 inches. The mollic epipedon is 20 to 35 inches thick. Reaction is - medium acid to neutral throughout the profile.

The A1 horizon has value of 3 to 5 when dry and 2 or 3 when moist and chroma of 1 to 3 when dry and moist. The A2 horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It is cobbly, very cobbly, or very gravelly silt loam.

The 2BAt horizon has hue of 7.5YR or 10YR, value of 3 to 5 when dry and 3 or 4 when moist, and chroma of 2 or 3 when dry and moist. It is very cobbly silty clay loam, very cobbly clay loam, or very gravelly loam.

The 2Bt horizon has hue of 5YR to 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry and 2 to 4 when moist. It is very cobbly clay loam, extremely cobbly clay, or extremely gravelly clay loam.

Gwinly Series

The Gwinly series consists of shallow, well drained soils on canyon walls and shoulder slopes. These soils formed in loess and in colluvium derived from weathered basalt. Slopes are 3 to 120 percent. Elevation is 1,400 to 4,100 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 100 to 135 days.

These soils are clayey-skeletal, montmorillonitic, mesic Lithic Argixerolls.

Typical pedon of Gwinly very stony silt loam, in an area of Gwinly-Mallory very stony silt loams, 30 to 70 percent slopes, about 3 miles southwest of Cloverland; 1,220 feet north and 2,000 feet west of the southeast corner of sec. 29, T. 9 N., R. 44 E.

A-0 to 3 inches; dark grayish brown (10YR 4/2) very stony silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; common very fine irregular pores; about 25 percent pebbles, 10 percent cobbles, and 10 percent stones; neutral; clear wavy boundary.

BAt-3 to 11 inches; dark grayish brown (10YR 4/2) very cobbly silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; many very fine and common fine roots; few very fine tubular pores; many thin stress cutans and clay films on faces of peds; about 25 percent pebbles, 25 percent cobbles, and 5 percent stones; neutral; clear wavy boundary.

Bt-11 to 15 inches; brown (10YR 4/3) extremely cobbly clay, dark brown (10YR 3/3) moist; moderate very fine angular blocky structure; very hard, firm, very sticky and very plastic; common very fine and few fine roots; few very fine tubular pores; continuous thick stress cutans and clay films on faces of peds; about 30 percent pebbles, 30 percent cobbles, and 10 percent stones; neutral; abrupt wavy boundary.

2R-15 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 10 to 20 inches. The mollic epipedon is 10 to 20 inches thick and includes all or part of the argillic horizon.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and 1 or 2 when moist. The BAt and Bt horizons have hue of 5YR, 7.5YR, or 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and moist. The BAt horizon is very cobbly clay loam, very gravelly silty clay loam, or very cobbly silty clay loam. The Bt horizon is very cobbly or extremely cobbly clay.

Harlow Series

The Harlow series consists of shallow, well drained soils on canyon walls, mountain plateaus and benches, ridgetops, and shoulder slopes. These soils formed in loess, colluvium, and slope alluvium derived from weathered basalt. Slopes are 3 to 90 percent. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 115 days.

These soils are clayey-skeletal, montmorillonitic, frigid Lithic Argixerolls

Typical pedon of Harlow very stony clay loam, in an area of Harlow-Snell very stony clay loams, 30 to 70 percent slopes, about 9 miles southeast of Anatone; 1,400 feet north and 2,400 feet west of the southeast corner of sec. 12, T. 6 N., R. 46 E.

A1-0 to 3 inches; dark grayish brown (10YR 4/2) very stony clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; hard, firm, sticky and plastic; many very fine roots; many very fine irregular pores; about 30 percent pebbles, 10 percent cobbles, and 5 percent stones; neutral; clear wavy boundary.

A2-3 to 6 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; hard, firm, sticky and plastic; many very fine roots; many irregular pores; about 30 percent pebbles and 10 percent cobbles; neutral; clear wavy boundary.

BAt-6 to 10 inches; brown (10YR 5/3) very cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; many very fine and few medium roots; common very fine irregular pores; continuous thin stress cutans and clay films on faces of peds; about 25 percent pebbles and 30 percent cobbles; neutral; clear wavy boundary.

Bt-10 to 14 inches; brown (10YR 4/3) extremely cobbly clay, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine and few medium roots; common very fine irregular pores; continuous moderately thick stress cutans on faces of peds and clay films lining some pores; about 30 percent pebbles and 35 percent cobbles; neutral; abrupt irregular boundary.

R-14 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 10 to 20 inches. The mollic epipedon is 10 to 20 inches thick and includes all of the argillic horizon.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and 1 to 3 when moist. The A2 horizon is very cobbly or very gravelly clay loam.

The BAt and Bt horizons have hue of 5YR, 7.5YR, or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and moist. The BAt horizon is very cobbly clay loam or very cobbly clay. The Bt horizon is extremely gravelly clay loam, extremely cobbly clay, very cobbly clay loam, or very cobbly clay.

Harlow Variant

The Harlow Variant consists of very shallow, well drained soils on ridgetops, shoulder slopes, mountain plateaus, and benches. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 30 percent. Elevation is 3,200 to 5,000 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 115 days.

These soils are clayey-skeletal, montmorillonitic, frigid Lithic Argixerolls.

Typical pedon of Harlow Variant *very* stony loam, in an area of the Harlow-Snell-Harlow Variant complex, 3 to 30 percent slopes, about 6 miles west of Anatone; 400 feet west and 600 feet south of the northeast corner of sec. 23, T. 8 N., R. 44 E.

A1-0 to 2 inches; dark grayish brown (10YR 4/2) very stony loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; hard, firm, sticky and plastic; many very fine roots; many very fine irregular pores; about 20 percent pebbles, 35 percent cobbles, and 1 percent stones; neutral; clear wavy boundary.

A2-2 to 5 inches; dark brown (7.5YR 3/2) very gravelly loam, very dark brown (7.5YR 2/2) moist; moderate medium and coarse granular structure; hard, firm, sticky and plastic; many very fine and few medium and coarse roots; common very fine irregular pores; about 30 percent pebbles and 15 percent cobbles; neutral; clear wavy boundary.

Bt-5 to 9 inches; dark brown (7.5YR 3/2) extremely cobbly clay loam, very dark brown (7.5YR 2/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common very fine and few medium roots; common very fine irregular pores; continuous moderately thick stress cutans and clay films on faces of peds; about 30 percent pebbles and 55 percent cobbles; neutral; abrupt irregular boundary.

R-9 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 5 to 10 inches. The mollic epipedon is 5 to 10 inches thick and includes all of the argillic horizon.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and moist. The A2 horizon is very gravelly loam, very gravelly clay loam, or very cobbly loam.

The Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and moist. It is extremely gravelly clay loam, extremely cobbly clay loam, or extremely cobbly clay.

Joseph Series

The Joseph series consists of very deep, moderately well drained soils on flood plains. These soils formed in basaltic alluvium. Slopes are 0 to 3 percent. Elevation is 750 to 1,600 feet. The average annual precipitation is 12 to 19 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 120 to 150 days.

These soils are sandy-skeletal, mixed, mesic Aquic Xerofluvents.

Typical pedon of Joseph extremely cobbly loamy sand, 0 to 3 percent slopes, about 10 miles southwest of Anatone; 475 feet west and 2,330 feet south of the northeast corner of sec. 33, T. 7 N., R. 44 E.

A-0 to 9 inches; dark grayish brown (10YR 4/2) extremely cobbly loamy sand, very dark brown (10YR 2/2) moist; single grained; loose; few very fine roots; about 30 percent pebbles, 35 percent cobbles, and 5 percent stones; neutral; clear wavy boundary.

C-9 to 60 inches; dark gray (10YR 4/1) extremely cobbly sand, very dark gray (10YR 3/1) moist; single grained; loose; few very fine roots; about 30 percent pebbles, 30 percent cobbles, and 5 percent stones; neutral.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. The C horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 1 to 3 when dry and moist. It is extremely cobbly coarse sand, extremely cobbly sand, or extremely cobbly loamy sand. The dark colors in these soils are inherited from the basalt. The content of organic matter is less than 1 percent.

Klicker Series

The Klicker series consists of moderately deep, well drained soils on ridgetops, mountain plateaus, and benches. These soils formed in loess and in slope alluvium and colluvium derived from weathered basalt. Slopes are 3 to 30 percent. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

These soils are loamy-skeletal, mixed, frigid Ultic Argixerolls.

Typical pedon of Klicker very stony silt loam, 3 to 30 percent slopes, about 16 miles southwest of Anatone; 1,400 feet south and 20 feet east of the northwest corner of sec. 8, T. 6 N., R. 43 E.

A-0 to 4 inches; dark brown (10YR 4/3) very stony silt loam, dark brown (10YR 3/3) moist; moderate fine granular structure; soft, friable, slightly sticky and slightly plastic; many very fine and fine and few medium roots; many very fine and fine irregular pores; about 20 percent pebbles, 10 percent cobbles, and 10 percent stones; slightly acid; clear wavy boundary.

AB-4 to 11 inches; dark brown (10YR 4/3) very cobbly silt loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many *very* fine and fine, common medium, and few coarse roots; common very fine and fine irregular pores; about 20 percent pebbles, 25 percent cobbles, and 5 percent stones; slightly acid; clear wavy boundary.

Bt1-11 to 19 inches; brown (10YR 4/3) extremely cobbly clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, firm, sticky and plastic; common very fine, fine, and medium and few coarse roots; common very fine and fine irregular pores; many thin stress cutans and clay films on faces of peds; about 25 percent pebbles, 35 percent cobbles, and 10 percent stones; slightly acid; clear wavy boundary.

Bt2-19 to 25 inches; brown (10YR 4/3) extremely cobbly clay loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine and few medium roots; common very fine and fine irregular pores; many thin stress cutans and clay films on faces of peds; about 20 percent pebbles, 35 percent cobbles, and 15 percent stones; slightly acid; abrupt irregular boundary.

2R-25 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 20 to 30 inches. The mollic epipedon is 15 to 20 inches thick and includes all or part of the argillic horizon.

The A horizon has hue of 7.5YR or 10YR and value of 4 or 5 when dry and 2 or 3 when moist. The AB horizon has hue of 7.5YR or 10YR. It is cobbly or very cobbly silt loam.

The Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 to 4 when dry and moist. It is very cobbly or extremely cobbly clay loam.

Laufer Series

The Laufer series consists of shallow, well drained soils on canyon walls. These soils formed in loess and in colluvium and slope alluvium derived from weathered basalt. Slopes are 30 to 120 percent. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

These soils are clayey-skeletal, montmorillonitic, mesic Lithic Argixerolls.

Typical pedon of Laufer very stony clay loam, in an area of the Laufer-Thiessen complex, 30 to 70 percent slopes, about 14 miles southwest of Asotin; 1,200 feet south and 2,300 feet east of the northwest corner of sec. 18, T. 9 N., R. 44 E.

A-0 to 3 inches; brown (10YR 4/3) very stony clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, firm, sticky and plastic; many very fine and common fine roots; many very fine irregular pores; about 25 percent pebbles, 15 percent cobbles, and 10 percent stones; neutral; clear wavy boundary.

BAt-3 to 10 inches; brown (10YR 4/3) very cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; many very fine and few fine roots; common very fine irregular pores; many thin stress cutans and clay films on faces of peds; about 15 percent pebbles, 20 percent cobbles, and 10 percent stones; neutral; clear wavy boundary.

Bt-10 to 15 inches; brown (10YR 4/3) extremely cobbly clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common very fine and few fine roots; common very fine tubular pores; continuous moderately thick stress cutans and clay films on faces of peds; about 25 percent pebbles, 35 percent cobbles, and 10 percent stones; neutral; abrupt wavy boundary.

2R-15 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 10 to 20 inches. The mollic epipedon is 10 to 20 inches thick and includes all of the argillic horizon.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 1 to 3 when dry and moist. The BAt horizon has hue of 7.5YR or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 1 to 3 when dry and moist. It is very cobbly or very gravelly clay loam. It is neutral or mildly alkaline. The Bt horizon has hue of 5YR. 7.5YR, or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 1 to 3 when dry and moist. It is very cobbly clay, very cobbly clay loam, or extremely cobbly clay loam. It is neutral or mildly alkaline.

Lawyer Series

The Lawyer series consists of deep and very deep well drained soils on north-facing canyon walls. These soils formed in loess and in colluvium derived from weathered basalt. Slopes are 30 to 90 percent. Elevation is 1,400 to 3,200 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 110 to 135 days.

These soils are loamy-skeletal, mixed, mesic Pachic Ultic Argixerolls.

Typical pedon of Lawyer stony silt loam, in an area of the Lawyer-Gwinly complex, 40 to 90 percent slopes, about 6 miles east of Anatone; 1,100 feet west and 1,300 feet north of the southeast corner of sec. 23, T. 8 N., R. 56 E.

A1-0 to 4 inches; very dark grayish brown (10YR 3/2) stony silt loam, black (10YR 2/1) moist; moderate fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 5 percent pebbles and 2 percent stones; neutral; clear wavy boundary.

A2-4 to 11 inches; very dark grayish brown (10YR 3/2) gravelly silt loam, black (10YR 2/1) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and few medium roots; many very fine irregular pores; about 15 percent pebbles and 5 percent cobbles; neutral; clear wavy boundary.

2BAt-11 to 16 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and few medium roots; many very fine irregular and few very fine tubular pores; many thin stress cutans and clay films on faces of peds; about 25 percent pebbles, 10 percent cobbles, and 5 percent stones; neutral; clear wavy boundary.

2Bt1-16 to 23 inches; brown (10YR 4/3) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; many very fine irregular and few very fine tubular pores; continuous thin stress cutans and clay films on faces of peds; about 30 percent pebbles, 10 percent cobbles, and 5 percent stones; neutral; clear wavy boundary.

2Bt2-23 to 35 inches; brown (10YR 4/3) very cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; many very fine irregular and few tubular pores; continuous moderately thick stress cutans and clay films on faces of peds; about 25 percent pebbles and 25 percent cobbles; neutral; clear wavy boundary.

2Bt3-35 to 44 inches; brown (10YR 5/3) very cobbly clay, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; common very fine roots; common very fine irregular pores; continuous moderately thick stress cutans and clay films on faces of peds; about 25 percent pebbles and 30 percent cobbles; neutral; abrupt irregular boundary.

R-44 inches; basalt.

The depth to lithic contact with basalt ranges from 40 to 60 inches. The mollic epipedon is 20 to 45 inches thick. Reaction is slightly acid or neutral throughout the profile.

The A1 horizon has value of 3 or 4 when dry and chroma of 1 or 2 when dry and moist. The A2 horizon is silt loam, gravelly silt loam, gravelly loam, or cobbly loam.

The BAt and Bt horizons have hue of 10YR or 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when moist and dry. The BAt horizon and the upper part of the Bt horizon are very gravelly or very cobbly clay loam. The lower part of the Bt horizon is very cobbly clay, very gravelly clay loam, extremely cobbly clay, or extremely gravelly clay loam. Some pedons are moderately alkaline and have lime below a depth of 44 inches.

Lickskillet Series

The Lickskillet series consists of shallow, well drained soils on canyon walls and shoulder slopes. These soils formed in colluvium derived from loess and weathered basalt. Slopes are 3 to 120 percent. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 190 days.

These soils are loamy-skeletal, mixed, mesic Lithic Haploxerolls.

Typical pedon of Lickskillet very stony loam, in an area of Lickskillet-Schuelke very stony loamy, 30 to 70 percent slopes, about 4 miles southeast of Asotin; 100 feet west and 1,500 feet north of the southeast corner of sec. 2, T. 9 N., R. 46 E.

A-0 to 4 inches; dark grayish brown (10YR 4/2) very stony loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 20 percent pebbles, 20 percent cobbles, and 10 percent stones; mildly alkaline; clear wavy boundary.

Bw-4 to 7 inches; dark grayish brown (10YR 4/2) very cobbly loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 20 percent pebbles and 30 percent cobbles; mildly alkaline; clear wavy boundary.

Bk-7 to 14 inches; light brownish gray (10YR 6/2) very cobbly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine irregular pores; common fine spheroidal aggregates of lime and many coatings of lime on the underside of basalt fragments; about 25 percent pebbles and 30 percent cobbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2R-14 inches; basalt.

The depth to lime generally ranges from 7 to 19 inches, but some pedons have no lime. The depth to lithic contact with basalt ranges from 10 to 20 inches. The mollic epipedon is 7 to 17 inches thick.

The A and Bw horizons have value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. The Bw horizon is *very* cobbly clay loam, very gravelly loam, or very cobbly loam. The Bk horizon has value of 4 to 8 when dry and 3 to 7 when moist and chroma of 2 or 3 when dry and moist. It is very cobbly clay loam, very gravelly clay loam, or very cobbly loam. It is mildly alkaline or moderately alkaline.

Limekiln Series

The Limekiln series consists of shallow, well drained soils on canyon walls and shoulder slopes. These soils formed in loess and in colluvium and slope alluvium derived from weathered basalt or greenstone. Slopes are 3 to 120 percent. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

These soils are loamy-skeletal, mixed, mesic Lithic Haploxerolls.

Typical pedon of Limekiln very stony silt loam, in an area of Limekiln-Thiessen Variant very stony silt loams, 30 to 70 percent slopes, about 7 miles south of Asotin; 1,000 feet south and 1,600 feet west of the northeast corner of sec. 27, T. 9 N., R. 46 E.

A1-0 to 4 inches; dark grayish brown (10YR 4/2) very stony silt loam, very dark brown (10YR 2/2) moist; moderate very fine and fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 25 percent pebbles, 15 percent cobbles, and 5 percent stones; mildly alkaline; clear wavy boundary.

A2-4 to 8 inches; dark grayish brown (10YR 4/2) very cobbly silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 20 percent pebbles and 25 percent cobbles; mildly alkaline; clear wavy boundary.

Bkg1-8 to 12 inches; brown (10YR 5/3) very cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; few fine spheroidal aggregates of lime and common coatings of lime and silica on the underside of basalt fragments; about 25 percent pebbles and 30 percent cobbles; strongly effervescent; moderately alkaline; clear wavy boundary.

Bkq2-12 to 16 inches; brown (10YR 5/3) extremely cobbly loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine irregular pores; common fine spheroidal aggregates of lime and many coatings of lime and silica on the underside of basalt fragments; about 35 percent pebbles and 40 percent cobbles; violently effervescent; strongly alkaline; abrupt irregular boundary.

2R-16 inches; basalt.

The depth to lime ranges from 7 to 12 inches. The depth to lithic contact with basalt or greenstone ranges from 10 to 20 inches. The mollic epipedon is 10 to 17 inches thick.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. The A2 horizon is very cobbly silt loam, very cobbly loam, very gravelly loam, or very gravelly silt loam.

The Bkg1 horizon has value of 5 or 6 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry and moist. It is very cobbly loam or very gravelly silt loam. The Bkq2 horizon has value of 5 to 7 when dry and 3 to 5 when moist and chroma of 1 to 3 when dry and moist. It is very cobbly or extremely cobbly loam. The Bkg1 and Bkq2 horizons are moderately alkaline or strongly alkaline.

Limekiln Variant

The Limekiln Variant consists of shallow, well drained soils on canyon walls. These soils formed in loess and in colluvium and slope alluvium derived from weathered limestone, shale, slate, and marine sandstone. Slopes are 30 to 90 percent. Elevation is 1,000 to 2,800 feet. The average annual precipitation is 16 or 17 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

These soils are loamy-skeletal, carbonatic, mesic, shallow Typic Calcixerolls.

Typical pedon of Limekiln Variant very gravelly loam, 30 to 70 percent slopes, about 7 miles southeast of Anatone; 500 feet south and 550 feet west of the northeast corner of sec. 30, T. 7 N., R. 47 E.

A-0 to 4 inches; grayish brown (10YR 5/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine irregular pores; about 35 percent pebbles and 5 percent cobbles; strongly effervescent; moderately alkaline; clear wavy boundary.

Bw-4 to 10 inches; light brownish gray (10YR 6/2) very gravelly loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine irregular pores; about 45 percent pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bk-10 to 15 inches; white (10YR 8/1) very gravelly loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, friable, sticky and plastic; common very fine and fine roots; common very fine and fine irregular pores; few coatings of lime in seams; about 55 percent pebbles; strongly effervescent; strongly alkaline; abrupt wavy boundary.

Cr-15 inches; weathered shale.

After the upper 7 inches is mixed, the entire profile is calcareous. The depth to paralithic contact with weathered shale, limestone, slate, or marine sandstone ranges from 10 to 20 inches. The mollic epipedon is 8 to 13 inches thick.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. The Bw horizon has value of 5 or 6 when dry and 4 or 5 when moist and chroma of 2 or 3 when dry and moist. It is very gravelly loam or very gravelly clay loam. The Bk horizon has value of 6 to 8 when dry and 5 or 6 when moist and chroma of 1 to 3 when dry and moist. It is very gravelly or extremely gravelly loam. It is moderately alkaline or strongly alkaline.

Linville Series

The Linville series consists of very deep, well drained soils on north-facing canyon walls. These soils formed in slope alluvium and colluvium derived from basalt and in loess and minor amounts of volcanic ash. Slopes are 40 to 90 percent. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 145 days.

These soils are fine-loamy, mixed, mesic Pachic Haploxerolls.

Typical pedon of Linville silt loam, in an area of the Matheny-Linville-Laufer complex, 40 to 90 percent slopes, about 9 miles south of Asotin; 2,200 feet north and 2,400 feet west of the southeast corner of sec. 4, T. 8 N., R. 46 E.

A1-0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, black (10YR 2/1) moist; weak fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 5 percent pebbles; neutral; clear wavy boundary.

A2-5 to 18, inches; very dark grayish brown (10YR 3/2) silt loam, black (10YR 2/1) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine, few medium, and few coarse roots; many very fine irregular pores; about 5 percent pebbles; neutral; clear wavy boundary.

AB-18 to 25 inches; dark grayish brown (10YR 4/2) cobbly silt loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and few coarse roots; common very fine irregular pores; about 5 percent pebbles and 15 percent cobbles; neutral; clear wavy boundary.

Bw1-25 to 38 inches; dark grayish brown (10YR 4/2) cobbly silt loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine roots; common very fine irregular pores; about 10 percent pebbles and 20 percent cobbles; neutral; clear wavy boundary.

Bw2-38 to 47 inches; dark grayish brown (10YR 4/2) very cobbly loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine irregular pores; about 20 percent pebbles, 30 percent cobbles, and 5 percent stones; clear wavy boundary.

BC-47 to 60 inches; brown (10YR 5/3) very cobbly loam, dark brown (10YR 3/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine irregular pores; about 25 percent pebbles and 30 percent cobbles; mildly alkaline.

The mollic epipedon is 20 to 47 inches thick. The A2 horizon has value of 3 or 4 when dry and chroma of 1 or 2 when dry and moist. The AB horizon has value of 3 or 4 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It is silt loam or cobbly silt loam.

The Bw horizon has value of 4 or 5 when dry and 2 to 4 when moist and chroma of 2 or 3 when dry and moist. It is neutral or mildly alkaline. The BC horizon has value of 4 to 6 when dry and 3 or 4 when moist. It is very cobbly loam or very cobbly clay loam. It is mildly alkaline or moderately alkaline.

Mallory Series

The Mallory series consists of moderately deep, well drained soils on canyon walls and shoulder slopes. These soils formed in loess and in slope alluvium and colluvium derived from weathered basalt. Slopes are 3 to 90 percent. Elevation is 1,400 to 4,200 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 110 to 135 days.

These soils are clayey-skeletal, montmorillonitic, mesic Pachic Argixerolls.

Typical pedon of Mallory very stony silt loam, in an area of Gwinly-Mallory very stony silt loams, 30 to 70 percent slopes, about 6 miles southwest of Anatone; 400 feet west and 1,200 feet north of the southeast corner of sec. 24, T. 7 N., R. 44 E.

A-0 to 4 inches; dark brown (10YR 3/3) very stony silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable, sticky and plastic; many very fine and few fine roots; many very fine irregular pores; about 25 percent pebbles, 10 percent cobbles, and 10 percent stones; neutral; clear wavy boundary.

AB-4 to 9 inches; dark brown (10YR 3/3) very cobbly clay loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; hard, firm, sticky and plastic; common very fine and few fine roots; common very fine tubular pores; about 20 percent pebbles and 30 percent cobbles; neutral; clear wavy boundary.

Bt1-9 to 20 inches; dark brown (10YR 3/3) very cobbly clay, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine roots; common very fine irregular and tubular pores; many thin stress cutans and clay films on faces of peds; about 25 percent pebbles and 30 percent cobbles; neutral; gradual wavy boundary.

Bt2-20 to 25 inches; dark brown (10YR 3/3) extremely cobbly clay, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine roots; common very fine irregular and tubular pores; continuous moderately thick stress cutans and clay films on faces of peds;

about 25 percent pebbles, 40 percent cobbles, and 5 percent stones; neutral; abrupt irregular boundary. R-25 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 20 to 40 inches. The mollic epipedon is 20 to 35 inches thick and includes all or part of the argillic horizon.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and 1 or 2 when moist. The AB horizon is very cobbly or very gravelly clay loam.

The Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and moist. It is very cobbly, extremely cobbly, or extremely gravelly clay.

Mallory Variant

The Mallory Variant consists of very deep, well drained soils on north-facing terrace escarpments. These soils formed in loess and in the underlying old alluvium. Slopes are 30 to 70 percent. Elevation is 1,800 to 3,000 feet. The average annual precipitation is 16 or 17 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 135 days.

These soils are clayey-skeletal, montmorillonitic, mesic Pachic Argixerolls.

Typical pedon of Mallory Variant, in an area of the Ferdinand Variant-Mallory Variant association, 8 to 70 percent slopes, about 2 miles south of Rogersberg; 1,700 feet east and 2,200 feet south of the northwest corner of sec. 30, T. 7 N., R. 47 E.

A1-0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, black (10YR 2/1) moist; weak very fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 5 percent pebbles; neutral; clear wavy boundary.

A2-4 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, black (10YR 2/1) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few medium roots; common very fine irregular pores; about 10 percent pebbles; neutral; clear wavy boundary.

2AB-10 to 15 inches; brown (7.5YR 4/2) very gravelly clay loam, dark brown (7.5YR 3/2) moist; strong fine subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine irregular pores; about 30 percent pebbles and 10 percent cobbles; neutral; clear wavy boundary.

2Bt1-15 to 24 inches; reddish brown (5YR 4/3) very gravelly clay, dark reddish brown (5YR 3/3) moist; strong fine subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; common very fine irregular pores; continuous thick stress cutans and clay films on faces of peds; about 30 percent pebbles and 10 percent cobbles; neutral; clear wavy boundary.

2Bt2-24 to 45 inches; reddish brown (5YR 4/4) very gravelly clay, reddish brown (5YR 4/3) moist; strong fine and medium subangular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; common very fine tubular and irregular pores; continuous thick stress cutans and clay films on faces of peds; about 35 percent pebbles and 15 percent cobbles; neutral; clear wavy boundary.

2Btk-45 to 60 inches; reddish brown (5YR 4/4) very cobbly clay, reddish brown (5YR 4/3) moist; strong fine and medium subangular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; common very fine tubular and irregular pores; continuous thick stress cutans and clay films on faces of peds; common coatings of lime on faces of peds; about 20 percent pebbles, 35 percent cobbles, and 5 percent stones; mildly alkaline.

The depth to lime ranges from 44 to more than 60 inches. The mollic epipedon is 20 to 35 inches thick.

The A horizon has value of 3 or 4 when dry and chroma of 1 or 2 when dry and moist. The AB horizon has hue of 10YR or 7.5YR and chroma of 2 or 3 when dry and moist.

The Bt horizon has hue of 7.5YR or 5YR, value of 3 or 4 when moist, and chroma of 2 to 4 when dry and moist. It is very gravelly clay, very cobbly clay, or very cobbly clay loam. The Btk horizon has value of 4 or 5 when dry and chroma of 3 or 4 when dry and moist. It is very cobbly clay, very gravelly clay loam, extremely cobbly clay, or very gravelly clay. It is mildly alkaline or moderately alkaline.

Matheny Series

The Matheny series consists of deep and very deep, well drained soils on canyon walls, slump blocks, and foot slopes. These soils formed in colluvium, slope alluvium derived from weathered basalt, and loess and some volcanic ash. Slopes are 10 to 90 percent. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 145 days.

These soils are loamy-skeletal, mixed, mesic Calcic Pachic Argixerolls.

Typical pedon of Matheny silt loam, in an area of Matheny-Linville silt loamy, 30 to 90 percent slopes, about 5 miles northeast of Anatone; 600 feet east and 2,100 feet north of the southwest corner of sec. 34, T. 9 N., R. 46 E.

A1-0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, black (10YR 2/1) moist; weak fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 5 percent pebbles; neutral; clear *wavy* boundary.

A2-4 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, black (10YR 2/1) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few medium roots; many very fine irregular pores; about 5 percent pebbles; neutral; clear wavy boundary.

AB-8 to 14 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few medium roots; common very fine irregular pores; about 5 percent pebbles; neutral; clear wavy boundary.

2Bt-14 to 22 inches; dark grayish brown (10YR 4/2) very cobbly clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; common very fine irregular pores; many thin stress cutans and clay films on faces of peds and clay films lining some pores; about 20 percent pebbles and 25 percent cobbles; neutral; clear wavy boundary.

2Bk1-22 to 33 inches; brown (10YR 5/3) extremely cobbly loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine irregular pores; common coatings of secondary lime on the underside of basalt fragments and few irregular coarse masses of lime; about 30 percent pebbles, 30 percent cobbles, and 5 percent stones; slightly effervescent; moderately alkaline; clear wavy boundary.

2Bk2-33 to 44 inches; brown (10YR 5/3) extremely cobbly loam, dark brown (10YR 3/3) moist; massive; hard, friable, sticky and plastic; few very fine roots; common very fine irregular pores; many coatings of lime on the underside of basalt fragments and common irregular coarse masses of lime; about 30 percent pebbles, 40 percent cobbles, and 5 percent stones; strongly effervescent; strongly alkaline; abrupt irregular boundary.

3R-44 inches; basalt.

The depth to lime ranges from 20 to 40 inches. The depth to lithic contact with basalt ranges from 40 to more than 60 inches. The mollic epipedon is 20 to 35 inches thick and includes all or part of the argillic horizon.

The A2 horizon has value of 3 or 4 when dry and chroma of 1 or 2 when dry and moist. It is silt loam, gravelly silt loam, or cobbly silt loam.

The AB horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It is silt loam, gravelly silt loam, cobbly silt loam, cobbly loam, or very cobbly loam.

The Bt horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It is very gravelly clay loam, very cobbly clay loam, very gravelly loam, or very cobbly loam. It is neutral or mildly alkaline. Some pedons have a Btk horizon.

The Bk horizon has value of 5 to 7 when dry and 3 to 5 when moist and chroma of 2 or 3 when dry and moist. It is extremely cobbly loam, very cobbly loam, extremely gravelly loam, very gravelly clay loam, or very cobbly clay loam. It is moderately alkaline or strongly alkaline.

Matheny Variant

The Matheny Variant consists of deep, well drained soils on north-facing canyon walls. These soils formed in loess and in colluvium and slope alluvium derived from weathered limestone, shale, slate, and marine sandstone. Slopes are 60 to 90 percent. Elevation is 1,000 to 2,800 feet. The average annual precipitation is 16 or 17 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 145 days.

These soils are fine-loamy, carbonatic, mesic Typic Calcixerolls.

Typical pedon of Matheny Variant silt loam, in an area of the Matheny Variant-Limekiln Variant complex, 60 to 90 percent slopes, about 1 mile south of Rogersburg; 550 feet west and 1,000 feet south of the northeast corner of sec. 30, T. 7 N., R. 47 E.

A1-0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine irregular pores; about 5 percent pebbles; mildly alkaline; clear wavy boundary.

A2-5 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine irregular pores; about 10 percent pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

Bw-13 to 18 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, sticky and plastic; many very fine and fine roots; common very fine irregular pores; about 10 percent pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

2Bk1-18 to 28 inches; pale brown (10YR 6/3) gravelly loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; common very fine irregular and few very fine tubular pores; common coatings of lime on faces of peds and lining pores; about 25 percent pebbles; strongly effervescent; strongly alkaline; clear wavy boundary.

2Bk2-28 to 37 inches; pale brown (10YR 6/3) gravelly loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; common very fine irregular and few very fine tubular pores; few coatings of lime on faces of peds; about 30 percent pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

2Bk3-37 to 43 inches; pale brown (10YR 6/3) very gravelly loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; common very fine irregular pores; few fine spheroidal aggregates of lime; about 50 percent pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2Cr-43 inches; weathered shale.

After the upper 7 inches is mixed, the entire profile is calcareous. The depth to paralithic contact with weathered shale, limestone, slate, or marine sandstone ranges from 40 to 60 inches. The mollic epipedon is 15 to 20 inches thick.

The A horizon has value of 3 or 4 when dry and chroma of 1 or 2 when dry and moist. The Bw horizon has value of 5 or 6 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry and moist. It is silt loam, loam, gravelly loam, or gravelly silt loam. The 2Bk horizon has value of 6 or 7 when dry and 5 or 6 when moist and chroma of 2 or 3 when dry and moist. It is gravelly loam, gravelly clay loam, very gravelly loam, or very gravelly clay loam. It is moderately alkaline or strongly alkaline.

Nansene Series

The Nansene series consists of very deep, well drained soils on north-facing hillslopes and canyon walls. These soils formed in loess. Slopes are 30 to 60 percent. Elevation is 1,000 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 160 days.

These soils are coarse-silty, mixed, mesic Pachic Haploxerolls.

Typical pedon of Nansene silt loam, 40 to 60 percent slopes, about 6 miles west of Clarkston; 1,000 feet east and 2,500 feet north of the southwest corner of sec. 5, T. 10 N., R. 45 E.

A1-0 to 4 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; mildly alkaline; clear wavy boundary.

A2-4 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky and weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; mildly alkaline; clear *wavy* boundary.

A3-12 to 17 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; mildly alkaline; clear wavy boundary.

AB-17 to 26 inches; brown (10YR 4/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; mildly alkaline; clear wavy boundary.

Bw-26 to 44 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine irregular and common tubular pores; mildly alkaline; clear wavy boundary.

Bk-44 to 60 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine irregular pores; few fine spheroidal aggregates of lime; strongly effervescent; moderately alkaline.

The depth to lime ranges from 44 to more than 60 inches. The mollic epipedon ranges from 20 to 35 inches.

The A horizon is neutral or mildly alkaline. The Bw horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. The Bk horizon has value of 5 or 6 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry and moist.

Neconda Series

The Neconda series consists of moderately deep, well drained soils on plateaus. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 15 percent. Elevation is 3,000 to 3,600 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 115 to 130 days.

These soils are fine, montmorillonitic, mesic Calcic Pachic Argixerolls.

Typical pedon of Neconda silty clay loam, 3 to 6 percent slopes (fig. 7), about 5 miles east of Anatone; 800 feet west and 2,200 feet south of the northeast corner of sec. 34, T. 8 N., R. 46 E.

Ap-0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, black (10YR 2/1) moist, moderate fine and medium granular structure; hard, firm, sticky and plastic; many very fine roots; common very fine irregular pores; neutral; abrupt smooth boundary.

A-8 to 12 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; common medium coatings on faces of peds, very dark brown (10YR 2/2) moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine irregular pores; neutral; clear wavy boundary.

Bt1-12 to 18 inches; brown (10YR 5/3) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; many thin stress cutans and clay films on faces of peds and clay films lining some pores; neutral; clear wavy boundary.

Bt2-18 to 27 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; continuous moderately thick stress cutans and clay films on faces of peds and clay films lining some pores; about 5 percent pebbles and 5 percent cobbles; neutral; clear wavy boundary.

Bt3-27 to 34 inches; brown (10YR 5/3) gravelly clay, dark yellowish brown (10YR 4/4) moist; dark brown (7.5YR 3/3) faces of peds when moist; strong medium angular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; continuous thick stress cutans and clay films on faces of peds; about 15 percent pebbles and 5 percent cobbles; neutral; abrupt wavy boundary.

2Bk-34 to 37 inches; very pale brown (10YR 7/3) very cobbly loam, brownish yellow (10YR 6/6) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; common very fine irregular pores; disseminated lime; violently effervescent; about 15 percent pebbles and 25 percent cobbles; moderately alkaline; abrupt irregular boundary.

3R-37 inches; basalt.

The depth to lime ranges from 20 to 36 inches. The depth to lithic contact with basalt ranges from 30 to 40 inches. The mollic epipedon is 20 to 30 inches thick and includes all or part of the argillic horizon.

The A horizon has value of 3 or 4 when dry and 2 or 3 when moist and chroma of 1 or 2 when dry and moist. It is slightly acid or neutral.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 to 4 when dry and moist. The upper part of this horizon is silty clay loam, silty clay, or clay. The lower part is gravelly or cobbly clay. This horizon is neutral or mildly alkaline throughout.

The Bk horizon has value of 6 to 8 when dry and 4 to 6 when moist and chroma of 2 or 3 when dry and 3 to 6 when moist. It is very cobbly loam, very gravelly loam, or gravelly clay loam. It is moderately alkaline or strongly alkaline. Some pedons have a thin Btk horizon directly above the fractured basalt.

Neissenberg Series

The Neissenberg series consists of moderately deep, moderately well drained soils on plateaus and hillslopes. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 40 percent. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

These soils are fine, mixed, mesic Duric Natrixerolls.

Typical pedon of Neissenberg silt loam, in an area of

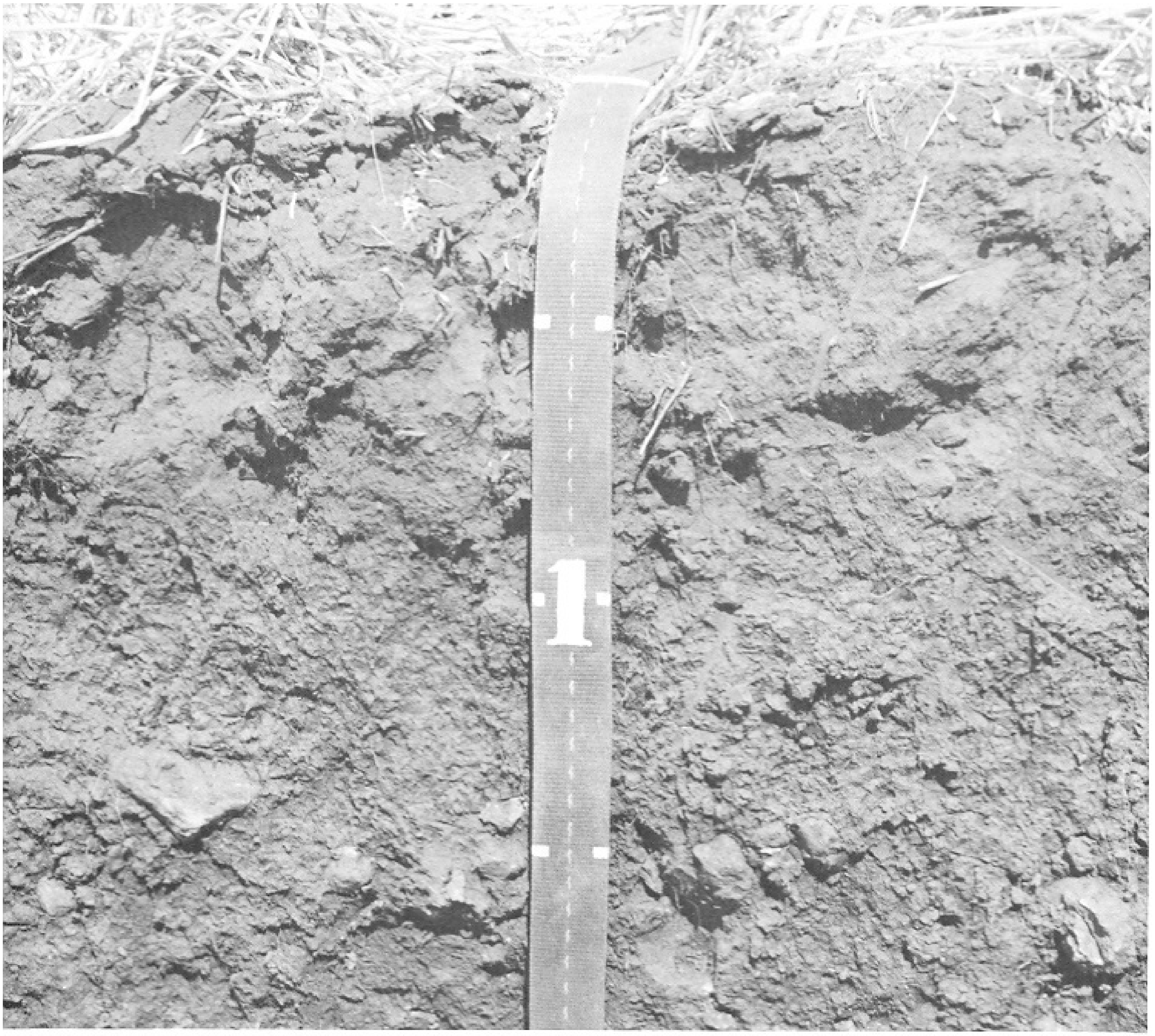

Figure 7.-Profile of Neconda silty clay loam, 3 to 6 percent slopes. A stone line is at a depth of about 17 inches. Depth is marked in feet.

Neissenberg-Pataha silt loams, 3 to 8 percent slopes, about 7 miles northwest of Anatone; 100 feet east and 1,700 feet south of the northwest corner of sec. 30, T. 9 N., R. 45 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; mildly alkaline; abrupt smooth boundary.

Btn1-7 to 12 inches; brown (10YR 5/3) silty clay, very dark grayish brown (10YR 3/2) moist; common very dark brown (10YR 2/2) organic coatings; strong medium prismatic structure parting to moderate fine and medium subangular blocky; very hard, very firm, sticky and plastic; many very fine roots; common very fine irregular pores; continuous moderately thick stress cutans and clay films on faces of peds and clay films lining some pores; mildly alkaline; clear wavy boundary.

Btn2-12 to 17 inches; brown (10YR 5/3) silty clay, very dark grayish brown (10YR 3/2) moist; strong medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, sticky and plastic; many very fine roots; many very fine irregular pores; continuous moderately thick stress cutans and clay films on faces of peds and clay films lining some pores; moderately alkaline; clear wavy boundary.

Btk-17 to 23 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common very fine roots; many very fine irregular pores; many thin stress cutans and clay films on faces of peds and clay films lining some pores; few aggregates of secondary lime; common coatings of secondary lime in pores and on faces of peds; about 10 percent pebbles; violently effervescent; moderately alkaline; abrupt wavy boundary.

2Bqk1-23 to 26 inches; light gray (10YR 7/2) very gravelly loam, pale brown (10YR 6/3) moist; .massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; discontinuous silica- and lime-cemented lenses 1/16 inch thick; about 30 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 20 percent silica- and lime-coated basalt cobbles; violently effervescent; moderately alkaline; clear wavy boundary.

2Bqk2-26 to 33 inches; light gray (10YR 7/2) very gravelly loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; about 30 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 15 percent silica- and lime-coated basalt cobbles; violently effervescent; moderately alkaline; abrupt wavy boundary.

R-33 inches; fractured basalt.

Depth to the calcic horizon ranges from 20 to 30 inches. The depth to lithic contact with basalt ranges from 30 to 40 inches. The natric horizon has an exchangeable sodium percentage of 15 to 30. The mollic epipedon is 15 to 20 inches thick and includes part of the natric horizon. Some pedons have a thin E horizon directly above the natric horizon.

The Btn horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It has prismatic, subangular blocky, or columnar structure. It is mildly alkaline or moderately alkaline.

The Btk horizon has value of 3 or 4 when moist and chroma of 2 or 3 when moist. It is silty clay loam or gravelly silty clay loam. It is moderately alkaline or strongly alkaline.

The Bqk horizon has value of 5 to 7 when dry and 4 to 7 when moist and chroma of 1 to 3 when dry and moist. It is very gravelly, extremely cobbly, or very cobbly loam. The coarse fragments include 20 to 50 percent silica- and lime-cemented fragments or silica- and lime-coated basalt fragments.

Nims Series

The Nims series consists of moderately deep, well drained soils on plateaus and hillslopes. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 30 percent. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

These soils are fine-loamy, mixed, mesic Calcic Haploxerolls.

Typical pedon of Nims silt loam, in an area of Weissenfels-Nims silt loams, 3 to 8 percent slopes, about 3 miles southwest of Asotin; 100 feet south and 150 feet east of the northwest corner of sec. 5, T. 9 N., R. 46 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium and coarse granular structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; mildly alkaline; abrupt smooth boundary.

A-7 to 15 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; mildly alkaline; clear *wavy* boundary.

Bw-15 to 19 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine irregular and common very fine tubular pores; mildly alkaline; clear wavy boundary.

Bk-19 to 26 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure; slightly hard, friable, sticky and plastic; common very fine roots; many very fine irregular and many very fine and fine tubular pores; few coatings of lime lining pores; about 10 percent pebbles; slightly effervescent; moderately alkaline; abrupt wavy boundary.

2Bgk1-26 to 29 inches; white (10YR 8/2) very cobbly loam, light gray (10YR 7/2) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; discontinuous silica- and lime-cemented lenses 1/8 inch thick; about 25 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 15 percent silica- and lime-coated basalt cobbles; violently effervescent; strongly alkaline; clear wavy boundary.

2Bqk2-29 to 35 inches; white (10YR 8/2) very gravelly loam, light gray (10YR 7/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; about 30 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 10 percent silica- and lime-coated basalt cobbles; violently effervescent; strongly alkaline; abrupt wavy boundary.

R-35 inches; basalt.

The depth to lime ranges from 13 to 26 inches. The depth to lithic contact with basalt ranges from 20 to 40 inches. The mollic epipedon is 7 to 20 inches thick.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is mildly alkaline or moderately alkaline.

The Bw horizon has value of 5 or 6 when dry and 3 or 4 when moist. It is mildly alkaline or moderately alkaline. The Bk horizon has value of 5 or 6 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry and moist. It is moderately alkaline or strongly alkaline. It is silt loam or gravelly silt loam.

The 2Bqk horizon has value of 6 to 8 when dry and 5 to 7 when moist and chroma of 1 to 3 when dry and moist. It is very gravelly, very cobbly, or gravelly loam. The coarse fragments include 20 to 50 percent silica- and lime-cemented fragments and silica- and lime-coated basalt fragments.

Olical Series

The Olical series consists of very deep, well drained soils on plateaus and hillslopes. These soils formed in loess. Slopes are 3 to 30 percent. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

These soils are coarse-silty, mixed, mesic Calcic Haploxerolls.

Typical pedon of Olical silt loam, in an area of Olical-Spofford silt loams, 3 to 8 percent slopes, about 3 miles north of Cloverland; 550 feet north and 550 feet west of the southeast corner of sec. 36, T. 10 N., R. 44 E.

Ap1-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; mildly alkaline; abrupt smooth boundary.

Ap2-7 to 10 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine irregular and common very fine tubular pores; mildly alkaline; abrupt smooth boundary.

Bw-10 to 17 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine irregular and common very fine tubular pores; mildly alkaline; clear wavy boundary.

Bk1-17 to 25 inches; pale brown (10YR 6/3) silt loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure; hard, firm, slightly sticky and slightly plastic; common very fine roots; common very fine tubular and common irregular pores; many coatings of secondary lime in pores; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2-25 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; few fine spheroidal aggregates of lime; strongly effervescent; moderately alkaline.

The depth to lime ranges from 15 to 44 inches. The mollic epipedon is 8 to 20 inches thick.

The Ap or A horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It is neutral or mildly alkaline.

The Bw horizon has value of 5 or 6 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry and moist. The Bk horizon has value of 5 or 6 when dry and 4 or 5 when moist and chroma of 2 or 3 when dry and moist. It is moderately alkaline or strongly alkaline. It has few to many fine or medium segregations of lime.

Olot Series

The Olot series consists of moderately deep, well drained soils on north-facing mountain plateaus and mountainsides. These soils formed in a mantle of volcanic ash and in the underlying loess and material weathered from basalt. Slopes are 3 to 30 percent. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 60 to 110 days.

These soils are ashy over loamy-skeletal, mixed, frigid Typic Vitrixerands.

Typical pedon of Olot silt loam, 3 to 30 percent slopes, about 9 miles west of Anatone; 500 feet east and 820 feet north of the southwest corner of sec. 21, T. 8 N., R. 44 E.

Oi&Oe-2 inches to 0; needles, twigs, and partially decomposed litter.

A-0 to 2 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and few fine and medium roots; many very fine irregular pores; neutral; clear wavy boundary.

Bw1-2 to 4 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine and few medium and coarse roots; common very fine irregular pores; neutral; clear wavy boundary.

Bw2-4 to 15 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine, fine, medium, and coarse roots; common very fine irregular pores; slightly acid; gradual wavy boundary.

2Btb1-15 to 21 inches; brown (10YR 5/3) very cobbly silt loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine, fine, and medium and few coarse roots; many very fine irregular and tubular pores; few thin stress cutans and clay films on faces of peds; about 25 percent cobbles and 15 percent pebbles; slightly acid; clear wavy boundary.

2Btb2-21 to 29 inches; brown (10YR 4/3) very cobbly silt loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine, fine, medium, and coarse roots; many very fine tubular and irregular pores; common thin stress cutans and clay films on faces of peds; about 25 percent cobbles and 15 percent pebbles; slightly acid; clear wavy boundary.

2Btb3-29 to 37 inches; dark brown (7.5YR 3/3) extremely cobbly silty clay loam, dark reddish brown (5YR 3/3) moist; moderate medium angular blocky structure; hard, firm, sticky and plastic; common very fine and fine and few medium roots; few very fine tubular pores; continuous moderately thick stress cutans and clay films on faces of peds; about 35 percent cobbles and 30 percent pebbles; slightly acid; abrupt wavy boundary.

3R-37 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 24 to 40 inches. The mantle of volcanic ash is 14 to 20 inches thick.

The A horizon has value of 4 or 5 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry and moist. It is slightly acid or neutral. The Bw horizon has value of 5 or 6 when dry and 3 or 4 when moist and chroma of 3 or 4 when dry and moist. The 2Btb horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 to 6 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry and moist. It is very cobbly silty clay loam, very cobbly silt loam, or extremely cobbly silty clay loam.

Pataha Series

The Pataha series consists of moderately deep, well drained soils on plateaus. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 15 percent. Elevation is 2,600 to 3,400 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 125 to 135 days.

These soils are fine-loamy, mixed, mesic Calcic Pachic Haploxerolls.

Typical pedon of Pataha silt loam, in an area of Neissenberg-Pataha silt loams, 3 to 8 percent slopes (fig. 8), about 7 miles northwest of Anatone; 200 feet south and 800 feet east of the northwest corner of sec. 26, T. 9 N., R. 44 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium and coarse granular structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; mildly alkaline; abrupt smooth boundary.

A-7 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, friable, sticky and plastic; many very fine roots; many very fine irregular and few fine tubular pores; mildly alkaline; clear wavy boundary.

ABk-13 to 17 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist;

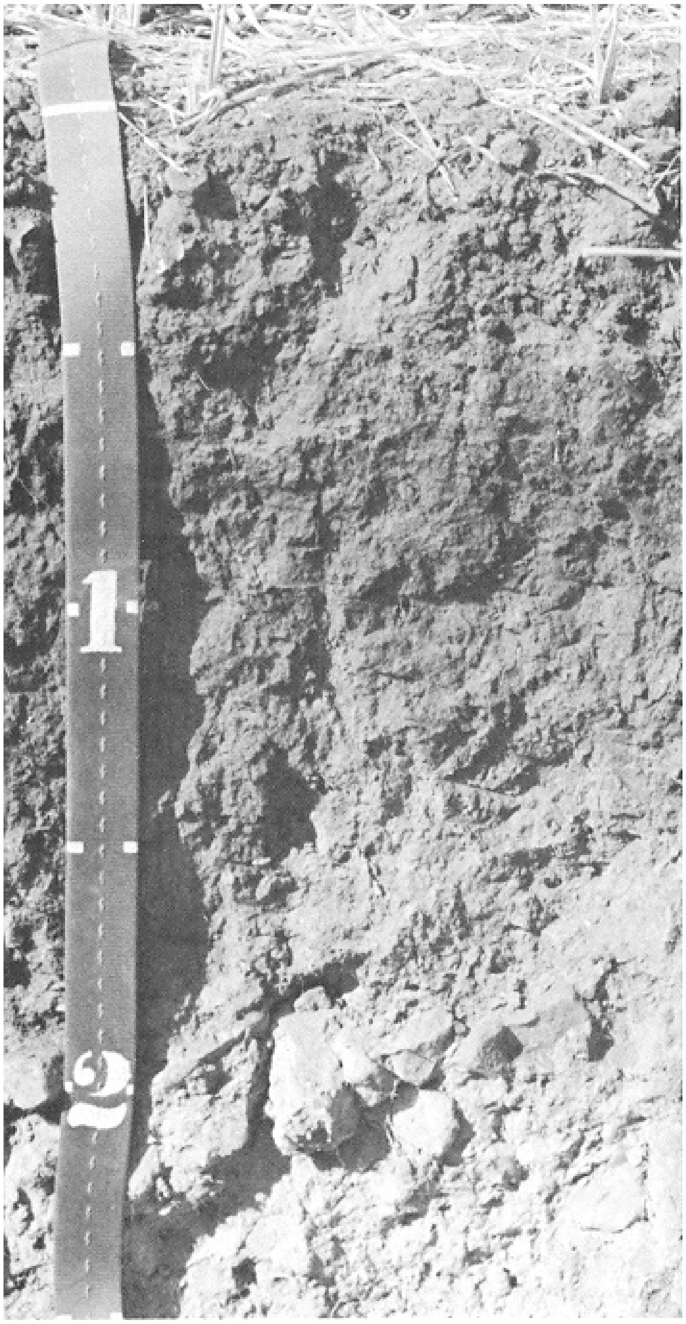

Figure 8.-Profile of Pataha silt loam, in an area of Neissenberg-Pataha silt loams, 3 to 8 percent slopes. Silica-cemented carbonates are at a depth of about 25 inches. Depth is marked in feet.

moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable, sticky and plastic; many very fine roots; many very fine irregular and common very fine and fine tubular pores; few fine spheroidal aggregates of lime; slightly effervescent; moderately alkaline; clear wavy boundary.

Bk-17 to 25 inches; grayish brown (10YR 5/2) gravelly silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm, sticky and plastic; common very fine roots; many very fine irregular and common very fine and fine tubular pores; common fine spheroidal aggregates of lime; about 20 percent pebbles and 5 percent cobbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2Bgk1-25 to 28 inches; light gray (10YR 7/2) very cobbly loam, brown (10YR 5/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; common very fine irregular and tubular pores; many aggregates of lime; discontinuous silica- and lime-cemented lenses 1/6 to 1/2 inch thick; about 30 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 25 percent lime- and silica-coated basalt cobbles; violently effervescent; strongly alkaline; abrupt wavy boundary.

2Bqk2-28 to 33 inches; light gray (10YR 7/2) very gravelly loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine irregular and tubular pores; many aggregates of secondary lime; about 35 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 25 percent silica- and lime-coated basalt cobbles; violently effervescent; strongly alkaline; abrupt wavy boundary.

3R-33 inches; basalt.

The depth to lime ranges from 10 to 20 inches. The depth to lithic contact with basalt ranges from 30 to 40 inches. The mollic epipedon is 24 to 34 inches thick and includes the A and Bk horizons.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is mildly alkaline or moderately alkaline. The Bk horizon has chroma of 2 or 3 when dry and moist. It is gravelly silt loam or silt loam. The 2Bqk horizon has value of 6 to 8 when dry and 5 to 7 when moist and chroma of 1 to 3 when dry and moist. It is very gravelly, extremely cobbly, or very cobbly loam. The coarse fragments include 20 to 50 percent silica- and lime-cemented fragments and silica- and lime-coated basalt fragments.

Peola Series

The Peola series consists of moderately deep, well drained soils on plateaus and hillslopes. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 40 percent. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

These soils are fine-loamy, mixed, mesic Calcic Pachic Argixerolls.

Typical pedon of Peola silt loam, in an area of Peola-Neissenberg silt loams, 3 to 8 percent slopes, about 16 miles west of Asotin; 600 feet east and 1,600 feet south of the northwest corner of sec. 27, T. 10 N., R. 43 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; neutral; abrupt smooth boundary.

A-7 to 14 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable, sticky and plastic; many very fine roots; many very fine irregular and few very fine tubular pores; mildly alkaline; clear wavy boundary.

BAt-14 to 19 inches; brown (10YR 4/3) silt loam, dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable, sticky and plastic; many very fine roots; many very fine irregular and few tubular pores; common thin stress cutans on faces of peds and clay films lining some pores; mildly alkaline; clear wavy boundary.

Bt-19 to 25 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium and coarse subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular and common tubular pores; common thin stress cutans on faces of peds and clay films lining pores; about 10 percent pebbles; mildly alkaline; abrupt wavy boundary.

2Bgk1-25 to 28 inches; white (10YR 8/2) very cobbly loam, pale brown (10YR 6/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; common very fine irregular and few tubular pores; about 25 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 15 percent lime- and silica-coated basalt cobbles; violently effervescent; moderately alkaline; abrupt wavy boundary.

2Bqk2-28 to 36 inches; white (10YR 8/2) very cobbly loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine irregular and few tubular pores; about 25 percent pebbles and 20 percent cobbles; violently effervescent; moderately alkaline; abrupt wavy boundary.

3R-36 inches; basalt.

The depth to lime ranges from 24 to 34 inches. The depth to lithic contact with basalt ranges from 30 to 40 inches. The mollic epipedon is 24 to 34 inches thick and includes the entire solum above the calcic horizon.

The A horizon has value of 2 or 3 when moist and chroma of 2 or 3 when dry. It is neutral or mildly alkaline. The BAt horizon also is neutral or mildly alkaline. It is silt loam or silty clay loam.

The Bt horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It is silt loam, silty clay loam, gravelly silt loam, or gravelly silty clay loam. It is neutral or mildly alkaline.

The 2Bqk horizon has value of 6 to 8 when dry and 5 to 7 when moist and chroma of 1 to 3 when dry and moist. It is very gravelly, extremely cobbly, or very cobbly loam. The coarse fragments include 20 to 35 percent silica- and lime-cemented durinodes and silica- and lime-coated basalt fragments. This horizon is moderately alkaline or strongly alkaline.

Powwahkee Series

The Powwahkee series consists of very deep, well drained soils on plateaus and hillslopes. These soils formed in loess. Slopes are 3 to 30 percent. Elevation is 3,200 to 3,600 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 110 to 120 days.

These soils are fine-silty, mixed, mesic Pachic Ultic Argixerolls.

Typical pedon of Powwahkee silt loam, 3 to 6 percent slopes, about 5 miles southeast of Anatone; 1,200 feet north and 1,950 feet west of the southeast corner of sec. 3, T. 7 N., R. 46 E.

Ap-0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak very fine subangular blocky structure; hard, friable, sticky and-plastic; many very fine and few fine roots; common very fine and few fine irregular pores; slightly acid; abrupt smooth boundary.

A-8 to 22 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular and common *very* fine and fine tubular pores; slightly acid; clear wavy boundary.

Bt1-22 to 31 inches; brown (10YR 5/3) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure; hard, firm, sticky and plastic; common very fine roots; few thin stress cutans and clay films on faces of peds; few very fine iron and manganese concretions; neutral; clear wavy boundary.

Bt2-31 to 39 inches; brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure; hard, firm, sticky and plastic; common very fine roots; few very fine tubular pores; common thin stress cutans and clay films on faces of peds and clay films lining some pores; common very fine iron and manganese concretions; neutral; clear wavy boundary.

Bt3-39 to 46 inches; brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; continuous thin stress cutans and clay films on faces of peds and few thin clay films lining some pores; common very fine iron and manganese concretions; neutral; clear wavy boundary.

Bt4-46 to 51 inches; yellowish brown (10YR 5/4) silty clay, dark yellowish brown (10YR 4/4) moist; moderate medium angular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; common very fine tubular pores; continuous moderately thick stress cutans and clay films on faces of peds; common very fine iron and manganese concretions; neutral; clear wavy boundary.

Bt5-51 to 55 inches; brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; moderate medium angular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; few very fine tubular pores; continuous thin stress cutans on faces of peds; common very fine iron and manganese concretions; neutral; clear wavy boundary.

Btk-55 to 60 inches; brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; moderate medium angular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; few very fine tubular pores; many thin stress cutans on faces of peds; common very fine iron and manganese concretions; common coatings of lime in pores and on faces of peds; mildly alkaline.

The depth to lime is more than 44 inches. The mollic epipedon is 20 to 35 inches thick. The Ap and A horizons have value of 3 or 4 when dry and chroma of 1 to 3 when dry and moist. They are slightly acid or neutral. The lower part is silt loam or silty clay loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 to 4 when dry and moist. It has subangular or angular blocky structure. It is silty clay loam in the upper part and silty clay loam or silty clay in the lower part. It is neutral or mildly alkaline.

The Btk horizon has value of 5 or 6 when dry and 3 to 5 when moist and chroma of 2 to 4 when dry and moist. It is silty clay loam or silty clay. It is mildly alkaline or moderately alkaline. Some pedons do not have a Btk horizon.

Rockly Series

The Rockly series consists of very shallow, well drained soils on ridgetops and canyon walls. These soils formed in material weathered from basalt and in some loess. Slopes are 3 to 120 percent. Elevation is 900 to 4,100 feet. The average annual precipitation is 15 to 25 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is 110 to 145 days.

These soils are loamy-skeletal, mixed, mesic Lithic Haploxerolls.

Typical pedon of Rockly very cobbly loam, 3 to 30 percent slopes, about 6 miles east of Cloverland; 800 feet east and 2,010 feet south of the northwest corner of sec. 12, T. 9 N., R. 43 E.

A-0 to 3 inches; brown (10YR 4/3) very cobbly loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few fine and medium roots; few very fine tubular and irregular pores; about 25 percent pebbles, 20 percent cobbles, and 1 percent stones; neutral; clear wavy boundary.

AB-3 to 7 inches; brown (10YR 4/3) very cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few fine and medium roots; common very fine tubular pores; about 15 percent pebbles, 25 percent cobbles, and 5 percent stones; neutral; clear wavy boundary.

Bw-7 to 9 inches; brown (10YR 4/3) extremely cobbly clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine and few fine and medium roots; common very fine tubular pores;

about 30 percent pebbles, 40 percent cobbles, and 5 percent stones; neutral; abrupt wavy boundary. R-9 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 4 to 10 inches. The mollic epipedon is 4 to 10 inches thick and includes the entire solum.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. The Bw horizon has value of 4 or 5 when dry. It is very cobbly loam, extremely cobbly clay loam, very cobbly loam, or extremely gravelly loam.

Schuelke Series

The Schuelke series consists of moderately deep, well drained soils on canyon walls and shoulder slopes. These soils formed in loess and colluvium and slope alluvium derived from weathered basalt. Slopes are 3 to 90 percent. Elevation is 800 to 2,600 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 52 degrees F, and the average frost-free period is 135 to 160 days.

These soils are loamy-skeletal, mixed, mesic Calcic Argixerolls.

Typical pedon of Schuelke very stony loam, in an area of the Lickskillet-Schuelke-Rock outcrop complex, 40 to 90 percent slopes, about 3 miles south of Asotin; 400 feet north and 800 feet west of the southeast corner of sec. 35, T. 10 N., R. 46 E.

A-0 to 4 inches; dark grayish brown (10YR 4/2) very stony loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 30 percent pebbles, 15 percent cobbles, and 5 percent stones; mildly alkaline; clear wavy boundary.

AB-4 to 9 inches; dark grayish brown (10YR 4/2) very cobbly silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 20 percent pebbles and 30 percent cobbles; mildly alkaline; clear wavy boundary.

Btk1-9 to 13 inches; brown (10YR 5/3) very cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; many very fine irregular pores; few thin stress cutans and clay films on faces of peds; many fine spheroidal basalt fragments; about 25 percent pebbles and 30 percent cobbles; moderately alkaline; clear wavy boundary.

Btk2-13 to 22 inches; brown (10YR 5/3) extremely cobbly clay loam, dark brown (10YR 3/3) moist; massive; hard, firm, sticky and plastic; common very fine roots; many very fine irregular pores; many fine spheroidal aggregates of lime and common coatings of lime on the underside of basalt fragments; about 30 percent pebbles and 35 percent cobbles; moderately alkaline; abrupt irregular boundary.

2R-22 inches; basalt.

The depth to lime ranges from 7 to 13 inches. The depth to lithic contact with basalt ranges from 20 to 40 inches. The mollic epipedon is 7 to 17 inches thick.

The A and AB horizons have value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. The AB horizon is very cobbly silt loam, very cobbly loam, and very gravelly silt loam.

The Btk1 horizon has value of 5 or 6 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry and moist. It is very cobbly clay loam, very cobbly loam, extremely cobbly loam, extremely cobbly clay loam, or extremely gravelly loam. It is moderately alkaline or strongly alkaline.

The Btk2 horizon has value of 5 or 6 when dry and 3 to 5 when moist and chroma of 1 to 3 when dry and moist. It is very cobbly clay loam or extremely gravelly loam. It is moderately alkaline or strongly alkaline.

Snell Series

The Snell series consists of moderately deep, well drained soils on plateaus, mountainsides, shoulder slopes, ridgetops, and canyon walls. These soils formed in loess and colluvium derived from weathered basalt. Slopes are 3 to 90 percent. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 115 days.

These soils are clayey-skeletal, montmorillonitic, frigid Pachic Argixerolls.

Typical pedon of Snell very stony clay loam, in an area of Harlow-Snell very stony clay loams, 30 to 70 percent slopes, about 9 miles southeast of Anatone; 1,300 feet north and 2,600 feet west of the southeast corner of sec. 12, T. 6 N., R. 46 E.

A1-0 to 6 inches; very dark grayish brown (10YR 3/2) very stony clay loam, black (10YR 2/1) moist; moderate very fine and fine granular structure; hard, firm, sticky and plastic; many very fine roots; many very fine irregular pores; about 20 percent pebbles, 15 percent cobbles, and 5 percent stones; neutral; clear smooth boundary.

A2-6 to 12 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark brown (10YR 2/2) moist; moderate very fine, fine, and medium granular structure; hard, firm, sticky and plastic; many very fine and few medium roots; many very fine irregular pores; about 35 percent pebbles and 15 percent cobbles; neutral; clear wavy boundary.

BAt-12 to 17 inches; brown (10YR 4/3) very cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common very fine and few medium roots; common very fine irregular pores; continuous thin stress cutans and clay films on faces of peds; about 25 percent pebbles and 25 percent cobbles; neutral; clear wavy boundary.

Bt-17 to 25 inches; brown (10YR 5/3) extremely cobbly clay, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine and few medium roots; common very fine irregular pores; continuous moderately thick stress cutans and clay films on faces of peds; about 30 percent pebbles and 35 percent cobbles; neutral; abrupt irregular boundary.

R-25 inches; fractured basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 20 to 40 inches. The mollic epipedon is 20 to 30 inches thick and includes all or part of the argillic horizon. Reaction is medium acid to neutral throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and 1 to 3 when moist. The A2 horizon is very cobbly clay loam, very gravelly clay loam, gravelly silty clay loam, or silty clay loam.

The BAt and Bt horizons have hue of 5YR, 7.5YR, or 10YR, value of 3 to 5 when dry and 3 or 4 when moist, and chroma of 2 or 3 when dry and moist. The BAt horizon is gravelly silty clay, cobbly clay, cobbly silty clay, very cobbly clay, extremely cobbly clay, extremely cobbly clay loam, or very cobbly clay loam. The Bt horizon is extremely gravelly silty clay, extremely cobbly clay, very cobbly clay loam, or very gravelly silty clay.

Spofford Series

The Spofford series consists of very deep, moderately well drained soils on plateaus and hillslopes. These soils formed in loess. Slopes are 3 to 30 percent. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

These soils are fine-silty, mixed, mesic Typic Natrixerolls.

Typical pedon of Spofford silt loam, in an area of Olical-Spofford silt loams, 3 to 8 percent slopes, about 3 miles north of Cloverland; 200 feet west and 550 feet north of the southeast corner of sec. 36, T. 10 N., R. 44 E.

Ap1-0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; hard, firm, sticky and plastic; many very fine roots; many very fine irregular pores; mildly alkaline; abrupt smooth boundary.

Ap2-7 to 10 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; few medium vesicular, many very fine tubular, and many irregular pores; mildly alkaline; abrupt smooth boundary.

Btn1-10 to 15 inches; brown (10YR 5/3) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; very hard, firm, sticky and plastic; common very fine roots; common very fine irregular and few very fine tubular pores; many thin stress cutans and clay films on faces of peds; moderately alkaline; clear wavy boundary.

Btn2-15 to 23 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate coarse prismatic structure parting to coarse subangular blocky; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; few thin stress cutans and clay films on faces of peds; moderately alkaline; clear wavy boundary.

Bk1-23 to 29 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; hard, firm, slightly sticky and slightly plastic; common very fine roots; common very fine irregular and few very fine tubular pores; common coatings of lime lining pores; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2-29 to 60 inches; light gray (10YR 7/2) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine irregular and few very fine tubular pores; few coatings of secondary lime lining pores and few fine spheroidal aggregates of lime; violently effervescent; moderately alkaline.

The depth to lime ranges from 15 to 30 inches. The mollic epipedon is 10 to 20 inches thick.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. The Btn horizon has value of 4 to 6 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry and moist. It is silt loam or silty clay loam. It has weak or moderate prismatic, columnar, or subangular blocky structure. The Bk horizon has value of 5 to 7 when dry and 4 or 5 when moist and chroma of 2 or 3 when dry and moist. It is moderately alkaline or strongly alkaline.

Spofmore Series

The Spofmore series consists of very deep, moderately well drained soils on plateaus and hillslopes. These soils formed in loess. Slopes are 3 to 30 percent. Elevation is 2,600 to 3,700 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 115 to 135 days.

These soils are fine, mixed, mesic Typic Natrixerolls.

Typical pedon of Spofmore silt loam, in an area of Spofmore-Catheen silt loams, 3 to 8 percent slopes, about 6 miles northeast of Anatone; 1,100 feet north and 2,100 feet west of the southeast corner of sec. 28, T. 9 N., R. 46 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; neutral; abrupt smooth boundary.

Btn1-7 to 11 inches; brown (10YR 5/3) silty clay, very dark grayish brown (10YR 3/2) moist; many very dark brown (10YR 2/2) organic coatings on faces of peds; strong fine and medium prismatic structure parting to moderate medium angular blocky; very hard, very firm, sticky and plastic; common very fine roots; common very fine irregular pores; continuous moderately thick stress cutans and clay films on faces of peds and clay films lining some pores; mildly alkaline; clear wavy boundary.

Btn2-11 to 18 inches; brown (10YR 5/3) silty clay, dark brown (10YR 3/3) moist; common very dark brown (10YR 2/2) organic coatings on faces of peds; strong medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, sticky and plastic; common very fine roots; many *very* fine irregular and common very fine tubular pores; continuous moderately thick stress cutans and clay films on faces of peds and common moderately thick clay films lining some pores; moderately alkaline; clear wavy boundary.

Btk-18 to 24 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine irregular and common tubular pores; many thin stress cutans and clay films on faces of peds and clay films lining pores; common coatings of lime on faces of peds and lining pores; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk1-24 to 35 inches; light gray (10YR 7/2) silt loam, pale brown (10YR 6/3) moist; massive; hard, friable, sticky and plastic; few very fine roots; many very fine irregular pores; disseminated lime; violently effervescent; strongly alkaline; clear wavy boundary.

Bk2-35 to 44 inches; brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; many very fine irregular pores; common fine and medium spheroidal aggregates of lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk3-44 to 60 inches; brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; many very fine irregular pores; few fine and medium spheroidal aggregates of lime; slightly effervescent; moderately alkaline.

The depth to lime ranges from 20 to 30 inches. The mollic epipedon is 15 to 20 inches thick and includes part of the natric horizon. The natric horizon has an exchangeable sodium percentage of 15 to 30. Some pedons have a thin E horizon directly above the natric horizon.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is neutral or mildly alkaline.

The Btn horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It has prismatic, subangular blocky, or columnar structure.

The Btk horizon has value of 3 or 4 when moist and chroma of 2 or 3 when moist. It is moderately alkaline or strongly alkaline.

The Bk horizon has value of 5 to 7 when dry and 4 or 5 when moist and chroma of 2 or 3 when dry and moist. It is silt loam or silty clay loam. It is moderately alkaline or strongly alkaline.

Stember Series

The Stember series consists of moderately deep, well drained soils on plateaus and shoulder slopes. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 30 percent.

Elevation is 2,600 to 3,400 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 135 days.

These soils are loamy-skeletal, mixed, mesic Typic Calcixerolls.

Typical pedon of Stember silt loam, 3 to 8 percent slopes, about 6 miles north of Anatone; 300 feet east and 1,100 feet north of the southwest corner of sec. 30, T. 9 N., R. 46 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; about 5 percent pebbles; slightly effervescent; moderately alkaline; abrupt smooth boundary.

A-7 to 11 inches; dark grayish brown (10YR 4/2) gravelly silt loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; about 20 percent pebbles and 5 percent cobbles; strongly effervescent; moderately alkaline; clear wavy boundary.

2Bgk1-11 to 15 inches; brown (10YR 5/3) very cobbly silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular and common very fine tubular pores; few fine spheroidal aggregates of lime; about 25 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 20 percent silica- and lime-coated basalt cobbles; violently effervescent; moderately alkaline; abrupt wavy boundary.

2Bqk2-15 to 18 inches; white (10YR 8/2) very cobbly loam, very pale brown (10YR 7/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; many very fine irregular and tubular pores; discontinuous silica- and lime-cemented lenses 1/16 to 1 inch thick; about 25 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 30 percent silica- and lime-coated basalt cobbles; violently effervescent; strongly alkaline; abrupt wavy boundary.

2Bqk3-18 to 24 inches; white (10YR 8/2) very cobbly loam, very pale brown (10YR 7/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots, many very fine irregular and tubular pores; about 30 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 20 percent silica- and lime-coated basalt cobbles; violently effervescent; strongly alkaline; abrupt wavy boundary.

3R-24 inches; basalt.

After the upper 7 inches is mixed, the entire profile is calcareous. The depth to lithic contact with basalt ranges from 20 to 30 inches. The mollic epipedon is 14 to 20 inches thick and includes the A and Bk horizons.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is gravelly silt loam or silt loam.

The 2Bgk1 horizon has chroma of 2 or 3 when dry and moist. It is very cobbly, very gravelly, or gravelly silt loam. The 2Bkq2 and 2Bqk3 horizons have value of 6 to 8 when dry and 5 to 7 when moist and chroma of 1 to 3 when dry and moist. They are very gravelly, extremely cobbly, or very cobbly loam. The coarse fragments include 20 to 50 percent silica- and lime-cemented fragments and 15 to 30 percent silica- and lime-coated basalt fragments.

Sweitberg Series

The Sweitberg series consists of moderately deep, well drained soils on plateaus. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 15 percent. Elevation is 3,400 to 4,100 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 44 degrees F, and the average frost-free period is 90 to 115 days.

These soils are fine, montmorillonitic, frigid Pachic Argixerolls.

Typical pedon of Sweitberg silty clay loam, 3 to 8 percent slopes, about 2 miles south of Anatone; 30 feet south and 2,400 feet west of the northeast corner of sec. 12. T. 7 N., R. 45 E.

Ap-0 to 9 inches; dark grayish brown (10YR 4/2) silty clay loam, black (10YR 2/1) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; many very fine and few fine roots; few very fine tubular and irregular pores; slightly acid; abrupt smooth boundary.

BAt-9 to 16 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, firm, sticky and plastic; common very fine roots; common very fine and fine tubular pores; few thin stress cutans and clay films on faces of peds; about 5 percent pebbles; neutral; clear wavy boundary.

Bt1-16 to 28 inches; brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to strong medium angular blocky; very hard, firm, very sticky and very plastic;

common very fine roots; common very fine and few fine tubular pores; continuous moderately thick stress cutans and clay films on faces of peds and clay films lining some pores; about 5 percent pebbles and 5 percent cobbles; neutral; clear wavy boundary.

2Bt2-28 to 32 inches; brown (10YR 4/3) very cobbly clay, dark brown (10YR 3/3) moist; dark brown (7.5YR 3/3) faces of peds when moist; weak coarse prismatic structure parting to strong medium angular blocky; very hard, very firm, very sticky and very plastic; few very fine roots between peds; few very fine tubular pores; continuous thick stress cutans and clay films on faces of peds; about 15 percent pebbles and 25 percent cobbles; neutral; abrupt irregular boundary.

3R-32 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 30 to 40 inches. The mollic epipedon is 20 to 30 inches thick and includes the upper part of the argillic horizon. Reaction is slightly acid or neutral.

The A horizon has value of 3 or 4 when dry and chroma of 1 or 2 when dry and moist. The BAt, Bt, and 2Bt horizons have hue of 7.5YR or 10YR, value of 3 to 5 when dry and 2 to 4 when moist, and chroma of 2 or 3 when dry and moist. The BAt and Bt horizons are silty clay loam, silty clay, or clay. The 2Bt horizon is very cobbly clay, very gravelly clay, or gravelly silty clay.

Sweitberg Variant

The Sweitberg Variant consists of deep, well drained soils on plateaus. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 15 percent. Elevation is 3,400 to 4,100 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is about 44 degrees F, and the average frost-free period is 90 to 115 days.

These soils are fine, montmorillonitic, frigid Pachic Argixerolls.

Typical pedon of Sweitberg Variant silty clay loam, 8 to 15 percent slopes, about 9 miles southwest of Anatone; 430 feet north and 580 feet west of the southeast corner of sec. 9, T. 6 N., R. 44 E.

Ap-0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate medium and coarse granular structure; hard, firm, sticky and plastic; many very fine roots; common very fine irregular pores; slightly acid; abrupt smooth boundary.

A-7 to 12 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; common very fine irregular pores; slightly acid; clear wavy boundary.

BAt-12 to 22 inches; brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium angular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine irregular and few very fine tubular pores; continuous moderately thick stress cutans and clay films on faces of peds; about 5 percent pebbles; neutral; clear wavy boundary.

Bt1-22 to 26 inches; brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; moderate medium angular blocky structure; very hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; continuous thick stress cutans and clay films on faces of peds; about 5 percent pebbles; neutral; clear wavy boundary.

Bt2-26 to 40 inches; brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; moderate medium angular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; continuous thick stress cutans and clay films on faces of peds; about 5 percent pebbles; neutral; clear wavy boundary.

2Bt3-40 to 44 inches; brown (10YR 5/3) very cobbly clay, brown (10YR 4/3) moist; moderate medium angular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; continuous thick stress cutans and clay films on faces of peds; about 15 percent pebbles and 25 percent cobbles; neutral; abrupt irregular boundary.

3R-44 inches; basalt.

The depth to lithic contact with basalt ranges from 40 to 60 inches. The mollic epipedon is 20 to 35 inches thick. Reaction is slightly acid or neutral.

The A horizon has value of 3 or 4 when dry and 2 or 3 when moist and chroma of 1 or 2 when dry and moist. The Bt and 2Bt horizons have hue of 7.5YR or 10YR, value of 3 to 5 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry and moist. The Bt horizon is silty clay loam or silty clay. The 2Bt horizon is very cobbly clay, very gravelly clay loam, or gravelly silty clay.

Sweiting Series

The Sweiting series consists of moderately deep, well drained soils on mountain plateaus and benches. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 30 percent. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

These soils are fine, montmorillonitic, frigid Pachic Ultic Argixerolls.

Typical pedon of Sweiting silt loam, 3 to 30 percent slopes, about 8 miles west of Anatone; 700 feet north and 2,500 feet east of the southwest corner of sec. 16, T. 8 N., R. 44 E.

Oi&Oe-2 inches to 0; partially decomposed needles and twigs.

A-0 to 3 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; hard, firm, sticky and plastic; many very fine and fine and few medium roots; many very fine irregular pores; slightly acid; clear smooth boundary.

AB-3 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine and few medium roots; common very fine irregular pores; slightly acid; clear wavy boundary.

Bt1-9 to 15 inches; brown (10YR 4/3) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, firm, sticky and plastic; common very fine, fine, and medium and few coarse roots; common very fine irregular and few very fine tubular pores; common moderately thick stress cutans and clay films on faces of peds; about 5 percent pebbles; slightly acid; clear smooth boundary.

Bt2-15 to 18 inches; brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, firm, sticky and plastic; common very fine and fine and few medium roots; common very fine tubular pores; many moderately thick stress cutans and clay films on faces of peds; about 10 percent pebbles; slightly acid; clear smooth boundary.

2Bt3-18 to 22 inches; brown (10YR 4/3) very cobbly silty clay loam, dark brown (10YR 3/3) moist; dark brown (7.5YR 3/3) faces of peds when moist; strong medium and fine angular blocky structure; very hard, very firm, sticky and plastic; common very fine, fine, and medium roots; few fine tubular pores; continuous moderately thick stress cutans and clay films on faces of peds and clay films lining some pores; about 15 percent pebbles and 25 percent cobbles; medium acid; abrupt irregular boundary.

3R-22 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 20 to 40 inches. The mollic epipedon is 20 to 30 inches thick and includes all or part of the argillic horizon. The solum is medium acid or slightly acid.

The A horizon has value of 3 or 4 when dry and 2 or 3 when moist and chroma of 1 or 2 when dry and moist. The Bt and 2Bt horizons have hue of 7.5YR or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and moist. The Bt horizon is silty clay loam, silty clay, or clay. The 2Bt horizon is gravelly clay, very gravelly clay loam, or very cobbly silty clay loam.

Tamming Series

The Tamming series consists of deep, well drained soils on south-facing canyon walls. These soils formed in colluvium derived from loess, weathered basalt, and some volcanic ash. Slopes are 30 to 70 percent. Elevation is 1,800 to 4,000 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is 100 to 125 days.

These soils are loamy-skeletal, mixed, mesic Pachic Ultic Argixerolls.

Typical pedon of Tamming stony silt loam, in an area of the Gwinly-Tamming complex, 30 to 70 percent slopes, about 7 miles west of Cloverland; 700 feet south and 1,100 feet west of the northeast corner of sec. 15, T. 9 N., R. 43 E.

Oi&Oe-1 inch to 0; loose, partly decayed needles, twigs, and branches.

A-0 to 4 inches; dark grayish brown (10YR 4/2) stony silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; hard, friable, sticky and plastic; many very fine, fine, and medium roots; many very fine irregular pores; about 20 percent pebbles, 5 percent cobbles, and 2 percent stones; neutral; clear smooth boundary.

AB-4 to 11 inches; brown (10YR 5/3) very gravelly silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; many very fine and fine, common medium, and few coarse roots; many very fine irregular pores; about 30 percent pebbles and 10 percent stones; slightly acid; clear wavy boundary.

Bt1-11 to 22 inches; brown (10YR 5/3) very gravelly silty clay loam, dark brown (10YR 3/3) moist;

moderate medium subangular blocky structure; hard, firm, sticky and plastic; many very fine; common fine and medium, and few coarse roots; common very fine and few fine irregular pores; few thin stress cutans and clay films on faces of peds; about 35 percent pebbles and 5 percent cobbles; slightly acid; clear wavy boundary.

2Bt2-22 to 36 inches; brown (10YR 5/3) very gravelly clay loam, dark brown (10YR 3/3) moist; moderate medium and fine subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine and few medium roots; common very fine irregular and tubular pores; common thin stress cutans and clay films on faces of peds; about 40 percent pebbles and 10 percent cobbles; slightly acid; clear wavy boundary.

2Bt3-36 to 44 inches; brown (10YR 5/3) extremely cobbly clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine and few medium roots; common very fine irregular and few fine irregular pores; many thin stress cutans and clay films on faces of peds; about 40 percent pebbles and 30 percent cobbles; slightly acid; abrupt wavy boundary.

3R-44 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 40 to 60 inches. The mollic epipedon is 20 to 25 inches thick. Reaction is slightly acid or neutral.

The A horizon has value of 4 or 5 when dry and chroma of 2 or 3 when moist and dry. The AB horizon is cobbly, very gravelly, or *very* cobbly silt loam.

The Bt1 horizon has value of 4 or 5 when dry and chroma of 2 or 3 when moist. It is very gravelly silty clay loam, very cobbly clay loam, or cobbly loam. The 2Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry and moist. It is very gravelly, very cobbly, or extremely cobbly clay loam.

Thiessen Series

The Thiessen series consists of moderately deep, well drained soils on canyon walls. These soils formed in loess, colluvium, and slope alluvium derived from weathered basalt. Slopes are 30 to 90 percent. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 120 to 145 days.

These soils are clayey-skeletal, montmorillonitic, mesic Pachic Argixerolls.

Typical pedon of Thiessen very stony silt loam, in an area of the Laufer-Thiessen-Rock outcrop complex, 40 to 90 percent slopes, about 5 miles northeast of Anatone; 250 feet north and 2,600 feet west of southeast corner of sec. 2, T. 8 N., R. 46 E.

A-0 to 3 inches; brown (10YR 4/3) very stony silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; hard, friable, sticky and plastic; many very fine and few medium roots; many very fine irregular pores; about 25 percent pebbles, 15 percent cobbles, and 10 percent stones; neutral; clear wavy boundary.

BAt-3 to 9 inches; brown (10YR 4/3) very cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; many very fine and few medium roots; many very fine irregular pores; many thin stress cutans and clay films on faces of peds; about 20 percent pebbles, 25 percent cobbles, and 5 percent stones; neutral; clear wavy boundary.

Bt1-9 to 17 inches; brown (10YR 5/3) very cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine irregular pores; many thin stress cutans and clay films on faces of peds; about 20 percent pebbles, 25 percent cobbles, and 5 percent stones; mildly alkaline; clear wavy boundary.

Bt2-17 to 22 inches; brown (10YR 5/3) extremely cobbly clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine irregular pores; continuous thin stress cutans and clay films on faces of peds; about 30 percent pebbles, 30 percent cobbles, and 5 percent stones; mildly alkaline; abrupt irregular boundary.

2R-22 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 20 to 40 inches. The mollic epipedon is 20 to 35 inches thick and includes all or part of the argillic horizon.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 1 to 3 when dry and moist. The BAt and Bt1 horizons have hue of 7.5YR or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 1 to 3 when dry and moist. They are very cobbly or very gravelly clay loam. They are neutral or mildly alkaline.

The Bt2 horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when dry and moist. It is very cobbly clay, extremely cobbly clay loam, very cobbly clay loam, or extremely cobbly clay. It is neutral or mildly alkaline.

Thiessen Variant

The Thiessen Variant consists of moderately deep, well drained soils on canyon walls. These soils formed in loess, colluvium, and slope alluvium derived from weathered basalt and greenstone. Slopes are 30 to 90 percent. Elevation is 900 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

These soils are loamy-skeletal, mixed, mesic Calcic Argixerolls.

Typical pedon of Thiessen Variant very stony silt loam, in an area of Limekiln-Thiessen Variant very stony silt loams, 30 to 70 percent slopes, about 7 miles south of Asotin; 1,000 feet south and 1,700 feet west of the northeast corner of sec. 27. T. 9 N., R. 46 E.

A1-0 to 4 inches; dark grayish brown (10YR 4/2) very stony silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 25 percent pebbles, 10 percent cobbles, and 5 percent stones; mildly alkaline; clear wavy boundary.

A2-4 to 8 inches; dark grayish brown (10YR 4/2) very cobbly silt loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 15 percent pebbles and 25 percent cobbles; mildly alkaline; clear wavy boundary.

Btk1-8 to 22 inches; pale brown (10YR 6/3) very cobbly loam, brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine irregular pores; few thin stress cutans and clay films on faces of peds; few fine spheroidal aggregates of lime and common coatings of lime on the underside of basalt fragments; about 25 percent pebbles and 30 percent cobbles; strongly effervescent; moderately alkaline; clear wavy boundary.

Btk2-22 to 29 inches; light gray (10YR 7/2) extremely cobbly loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine irregular pores; many thin stress cutans and clay films on faces of peds; many fine spheroidal aggregates of lime and many coatings of lime on basalt fragments; about 35 percent pebbles and 40 percent cobbles; violently effervescent; strongly alkaline; abrupt irregular boundary.

2R-29 inches; basalt.

The depth to lime ranges from 8 to 14 inches. The depth to lithic contact with basalt ranges from 20 to 40 inches. The mollic epipedon is 10 to 17 inches thick.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. The A2 horizon is very cobbly silt loam, very cobbly loam, or very gravelly loam.

The Bkt1 horizon has value of 5 or 6 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry and moist. It is very cobbly loam, very cobbly clay loam, extremely cobbly loam, or very cobbly clay loam. It is moderately alkaline or strongly alkaline.

The Bkt2 horizon has value of 6 to 8 when dry and 5 to 7 when moist and chroma of 1 to 3 when dry and moist. It is very cobbly loam, very cobbly clay loam, extremely gravelly loam, or very cobbly clay loam. It is moderately alkaline or strongly alkaline.

Tolo Series

The Tolo series consists of deep, well drained soils on north-facing mountain plateaus and hillslopes. These soils formed in a mantle of volcanic ash and in the underlying loess and colluvium derived from weathered basalt. Slopes are 3 to 45 percent. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 22 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is 60 to 110 days.

These soils are ashy over loamy, mixed, frigid Alfic Vitrixerands.

Typical pedon of Tolo silt loam, 3 to 30 percent slopes, about 9 miles west of Anatone; 2,400 feet south and 2,500 feet east of the northwest corner of sec. 20. T. 8 N., R. 44 E.

Oi&Oe-3 inches to 0; partially decomposed needles and twigs.

A-0 to 4 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine and medium granular structure; soft, very friable, nonsticky and nonplastic; common fine and few medium and coarse roots; few fine irregular pores; slightly acid; clear smooth boundary.

Bw1-4 to 11 inches; light yellowish brown (10YR 6/4) silt loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine and few medium and coarse roots; few fine irregular pores; slightly acid:, gradual smooth boundary.

Bw2-11 to 16 inches; light yellowish brown (10YR 6/4) silt loam, dark yellowish brown (10YR 3/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and medium and few coarse roots; few fine irregular pores; slightly acid; clear smooth boundary.

Bw3-16 to 23 inches; light yellowish brown (10YR 6/4) silt loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and medium and few coarse roots; few fine irregular pores; slightly acid; gradual wavy boundary.

2Btb1-23 to 29 inches; yellowish brown (10YR 5/4) silt loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and medium and few coarse roots; few thin stress cutans and clay films on faces of peds; slightly acid; gradual wavy boundary.

2Btb2-29 to 42 inches; yellowish brown (10YR 5/4) silt loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine and medium roots; few fine irregular and tubular pores; common thin stress cutans and clay films on faces of peds; slightly acid; gradual wavy boundary.

2Btb3-42 to 47 inches; yellowish brown (10YR 5/4) silt loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine and medium roots; few fine irregular and few fine tubular pores; common thin stress cutans and clay films on faces of peds; slightly acid; abrupt smooth boundary.

2Btb4-47 to 55 inches; yellowish brown (10YR 5/4) gravelly silty clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few fine and medium roots; few fine irregular and few fine tubular pores; common thin stress cutans and clay films on faces of peds; about 20 percent pebbles and 5 percent cobbles; slightly acid; abrupt smooth boundary.

3R-55 inches; basalt.

The thickness of the solum and the depth to lithic contact with basalt range from 40 to 60 inches. The mantle of volcanic ash is 20 to 30 inches thick. Reaction is medium acid or slightly acid.

The A horizon has value of 4 or 5 when dry and 3 or 4 when moist and chroma of 2 or 3 when moist and dry. The Bw horizon has value of 5 or 6 when dry and chroma of 3 or 4 when dry. The 2Btb horizon has hue of 10YR or 7.5YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 3 or 4 when dry. The upper part of this horizon is silt loam or silty clay loam. The lower part is gravelly clay loam, gravelly silty clay loam, very cobbly clay loam, very cobbly silty clay loam, or very gravelly clay loam.

Tyee Series

The Tyee series consists of shallow, well drained soils on south-facing canyon walls. These soils formed in residuum and colluvium derived from weathered granodiorite. Slopes are 40 to 90 percent. Elevation is 1,000 to 2,400 feet. The average annual precipitation is 16 or 17 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is 120 to 145 days.

These soils are loamy, mixed, mesic, shallow Ultic Haploxerolls.

Typical pedon of Tyee gravelly sandy loam, in an area of the Tyee-Rock outcrop complex, 40 to 90 percent slopes, about 4 miles south of Rogersburg; 380 feet north and 1,000 feet west of the southeast corner of sec. 8, T. 6 N., R. 47 E.

A1-0 to 8 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark brown (10YR 2/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many very fine and common fine roots; common very fine irregular pores; about 15 percent pebbles; neutral; clear wavy boundary.

A2-8 to 14 inches; dark grayish brown (10YR 4/2) gravelly coarse sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and common fine roots; common very fine irregular pores; about 25 percent pebbles; neutral; abrupt wavy boundary.

Cr-14 inches; weathered granodiorite.

The depth to paralithic contact with weathered granodiorite ranges from 10 to 20 inches. The mollic epipedon is 10 to 18 inches thick.

The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist. The A2 horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist.

Tyee Variant

The Tyee Variant consists of deep, well drained soils on north-facing canyon walls. These soils formed in loess and colluvium derived from weathered granodiorite. Slopes are 40 to 90 percent. Elevation is 1,000 to 2,400 feet. The average annual precipitation is 16 or 17 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is 120 to 145 days.

These soils are fine-loamy, mixed, mesic Pachic Argixerolls.

Typical pedon of Tyee Variant loam, 40 to 90 percent slopes, about 4 miles south of Rogersburg; 650 feet west and 1,200 feet north of the southeast corner of sec. 8, T. 6 N., R. 47 E.

A1-0 to 4 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 10 percent pebbles; neutral; clear wavy boundary.

A2-4 to 22 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 10 percent pebbles; neutral; clear wavy boundary.

Btl-22 to 35 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; many very fine irregular pores; few thin stress cutans and clay films on faces of peds; about 10 percent pebbles; neutral; clear wavy boundary.

Bt2-35 to 45 inches; dark grayish brown (10YR 4/2) gravelly sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; many very fine irregular pores; common thin stress cutans and clay films on faces of peds; about 20 percent pebbles; neutral; abrupt wavy boundary.

2Cr-45 inches; weathered granodiorite.

The depth to paralithic contact with weathered granodiorite ranges from 40 to 60 inches. The mollic epipedon is 20 to 50 inches thick.

The A horizon has value of 3 or 4 when dry and chroma of 1 or 2 when dry and moist. The A2 horizon is loam or gravelly loam. The Bt horizon has value of 4 or 5 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry and moist. It is gravelly sandy clay loam or sandy clay loam.

Veazie Series

The Veazie series consists of very deep, well drained soils on flood plains and low terraces. These soils formed in alluvium. Slopes are 0 to 3 percent. Elevation is 750 to 2,500 feet. The average annual precipitation is 12 to 19 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 120 to 150 days.

These soils are coarse-loamy over sandy or sandy-skeletal, mixed, mesic Cumulic Haploxerolls.

Typical pedon of Veazie silt loam, 0 to 3 percent slopes, about 3 miles southwest of Rogersburg; 1,950 feet west and 2,600 feet south of the northeast corner of sec. 3, T. 6 N., R. 46 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine, medium, and coarse granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 5 percent pebbles; neutral; abrupt smooth boundary.

A1-7 to 17 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine, medium, and coarse granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; about 5 percent pebbles; neutral; clear wavy boundary.

A2-17 to 35 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine irregular pores; about 20 percent pebbles and 5 percent cobbles; neutral; clear wavy boundary.

2C-35 to 60 inches; dark gray (10YR 4/1) extremely cobbly coarse sand, very dark gray (10YR 3/1) moist; single grained; loose; few very fine roots; about 30 percent pebbles, 30 percent cobbles, and 10 percent stones; neutral.

Depth to the 2C horizon and the thickness of the mollic epipedon range from 20 to 40 inches. Reaction is neutral or slightly acid.

The Ap and Al horizons have value of 3 or 4 when dry and chroma of 1 or 2 when moist. The A2 horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. The Al and A2 horizons are silt loam or gravelly loam.

The 2C horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 1 to 3 when dry and moist. It is extremely cobbly coarse sand, extremely cobbly loamy sand, or extremely cobbly sand.

Veazie Variant

The Veazie Variant consists of very deep, moderately well drained soils on flood plains. These soils formed in alluvium. Slopes are 0 to 3 percent. Elevation is 750 to 2,500 feet. The average annual precipitation is 12 to 19 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 120 to 150 days.

These soils are loamy-skeletal, mixed, mesic Cumulic Haploxerolls.

Typical pedon of Veazie Variant cobbly loam, in an area of the Veazie-Veazie Variant complex, 0 to 3 percent slopes, about 10 miles west of Asotin; 2,200 feet north and 2,600 feet east of the southwest corner of sec. 3, T. 9 N., R. 44 E.

Ap-0 to 6 inches; dark grayish brown (10YR 4/2) cobbly loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; about 10 percent pebbles and 15 percent cobbles; neutral; abrupt smooth boundary.

A1-6 to 13 inches; dark grayish brown (10YR 4/2) very cobbly loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; about 20 percent pebbles and 25 percent cobbles; neutral; clear wavy boundary.

A2-13 to 33 inches; dark grayish brown (10YR 4/2) extremely cobbly loam, very dark brown (10YR 2/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; about 25 percent pebbles, 30 percent cobbles, and 10 percent stones; neutral; clear wavy boundary.

2C-33 to 60 inches; grayish brown (10YR 4/1) extremely cobbly coarse sand, very dark grayish brown (10YR 3/1) moist; single grained; loose; few very fine roots; common mottles; about 30 percent pebbles, 30 percent cobbles, and 10 percent stones; neutral.

Depth to the 2C horizon and the thickness of the mollic epipedon range from 20 to 40 inches. Reaction is neutral or slightly acid.

The Ap and A1 horizons have value of 3 or 4 when dry and chroma of 1 or 2 when moist. The Al horizon is very cobbly loam, extremely cobbly loam, or extremely cobbly sandy loam. The A2 horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry and moist. It is very cobbly loam, extremely cobbly loam, extremely cobbly sandy loam, or extremely cobbly coarse sandy loam.

The 2C horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 1 to 3 when dry and moist. It is extremely cobbly coarse sand, extremely cobbly loamy sand, or extremely cobbly sand.

Weissenfels Series

The Weissenfels series consists of moderately deep, moderately well drained soils on plateaus and hillslopes. These soils formed in loess and slope alluvium derived from weathered basalt. Slopes are 3 to 30 percent. Elevation is 1,200 to 2,700 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is about 51 degrees F, and the average frost-free period is 135 to 155 days.

These soils are fine, mixed, mesic Duric Natrixerolls.

Typical pedon of Weissenfels silt loam, in an area of Weissenfels-Nims silt loamy, 3 to 8 percent slopes, about 6 miles southwest of Asotin; 300 feet west and 1,000 feet south of the northeast corner of sec. 4, T. 9 N., R. 45 E.

Ap-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium and coarse granular structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; mildly alkaline; abrupt smooth boundary.

Btn1-7 to 12 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; common very dark brown (10YR 2/2) organic coatings on faces of peds; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very hard, very firm, sticky and plastic; many very fine roots; common very fine irregular pores; continuous moderately thick stress cutans and clay films on faces of peds and many moderately thick clay films lining pores; mildly alkaline; clear wavy boundary.

Btn2-12 to 15 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; many very fine irregular pores; many thin stress cutans and clay films on faces of peds and clay films lining some pores; moderately alkaline; clear wavy boundary.

Bk-15 to 22 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; common coatings of lime lining pores and few irregular coarse very pale brown (10YR 8/3) masses of lime; about 5 percent pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2Bgk1-22 to 25 inches; very pale brown (10YR 7/3) very gravelly loam, brown (10YR 5/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; discontinuous silica- and lime-cemented lenses 1/16 inch thick; about 25 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 15 percent silica- and lime-coated basalt cobbles; violently effervescent; strongly alkaline; clear wavy boundary.

2Bqk2-25 to 37 inches; white (10YR 8/1) very gravelly loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine irregular pores; about 25 percent pebble-sized durinodes and silica- and lime-coated basalt pebbles and 10 percent silica- and lime-coated basalt cobbles; violently effervescent; strongly alkaline; abrupt wavy boundary

3R-37 inches; basalt.

The depth to lime ranges from 20 to 30 inches. The depth to lithic contact with basalt ranges from 25 to 40 inches. The natric horizon has an exchangeable sodium percentage of 15 to 30. The mollic epipedon is 10 to 15 inches thick and includes part of the natric horizon. Some pedons have a thin E horizon directly above the natric horizon.

The Btn1 horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry. It has prismatic, subangular blocky, or columnar structure. It is mildly alkaline or moderately alkaline. The Btn2 horizon has chroma of 2 or 3 when moist.

The Bk horizon is silt loam or gravelly silt loam. It is moderately alkaline or strongly alkaline. The Bkq horizon has value of 6 to 8 when dry and 5 to 7 when moist and chroma of 1 to 3 when dry and moist. It is very gravelly loam, very cobbly loam, or gravelly loam. The coarse fragments include 20 to 50 percent silica- and lime-cemented fragments.

Formation of the Soils

Soil occurs as accumulated three-dimensional natural bodies of mineral and organic material that support plants at the earth's surface. The properties and characteristics of the soil at any given place are determined by soil-forming processes that result from the physical and mineralogical composition of the parent material, the climate under which the parent material accumulated and under which the soil has existed since accumulation, the topography, the living organisms on and in the soil, and the length of time that the processes of soil formation have acted on the parent material. There is a strong interdependence among all of these soil-forming factors.

Soil formation results from a combination of many processes acting in different proportions and intensities at different times and places on the landscape (21). The processes of soil formation include additions, removals, transfers, and transformations. Examples are the accumulation of organic matter and the translocation and accumulation of soluble salts and silicate clay minerals.

Parent Material

The nature of soils is strongly influenced by the character of the parent material, particularly by its mineralogy and texture, which affect various physical and chemical aspects of the soil-forming environment. The soils in this survey area formed mainly in colluvium, residuum, and slope alluvium derived from basalt and in loess, glaciofluvial deposits, volcanic ash, recent alluvium, and old alluvium (fig. 9). Some soils formed in material weathered from granodiorite, greenstone, shale, slate, limestone, and marine sandstone.

Alluvial deposits are on flood plains, low terraces, and alluvial fans. Postglacial or Holocene modifications of the landscape include very localized deposition of alluvium. Because of the nearly level topography of the flood plains and the shallow natural stream channels, some of the soils have a seasonally fluctuating groundwater level. Examples are the moderately well drained Bridgewater Variant and Veazie Variant soils, which are mottled because they are saturated with water during part of the year. These soils show little evidence of profile development other than the accumulation of organic matter in the surface layer. Bridgewater and Veazie soils, which are Cumulic Haploxerolls, are examples of well drained alluvial soils.

Glaciofluvial deposits and old alluvial sand and gravel deposits mantled with loess or sandy eolian material are on terraces and terrace escarpments. Large areas of terraces and terrace escarpments are in the northeastern part of the survey area, in the Snake River Canyon. Also, smaller areas are along the entire length of the Snake River in the survey area and along the Grande Ronde River. These parent materials are flood deposits from Glacial Lake Bonneville and glaciofluvial deposits from the flooding of Glacial Lake Missoula.

The overflow and rapid lowering of Glacial Lake Bonneville 15,000 to 14,000 years ago resulted in a cataclysmic flood down the Snake River Canyon that deposited old alluvial sand and gravel flood debris (25). The Bonneville flood deposits are overlain by glaciofluvial deposits that have numerous graded beds, which were deposited during periods of backwater flooding from Glacial Lake Missoula 16,000 to 12,000 years ago (25). The floodwater that deposited these beds flowed up the Snake River Canyon from the mouth of the Palouse River. Each bed represents a separate flooding of Glacial Lake Missoula. Some of the early deposits of the Missoula flood sequence probably have been buried by Bonneville flood deposits. The earliest known flooding of the Columbia Plateau in the Pleistocene is evidenced by several exposures of caliche-capped flood gravel (26).

Dallesport soils formed in old alluvial sand and gravel having a minor amount of eolian deposits in the upper part, and Chard soils formed in glaciofluvial deposits that have a mantle of loess. The development of a mollic epipedon and a cambic horizon is the dominant evidence of soil formation in these soils. Calcium carbonate has been leached to a depth of 20 to 35 inches in the Chard soils, which are Calcic Haploxerolls, and to a depth of 44 to 60 inches in the coarser textured Dallesport soils, which are Typic Haploxerolls.

Loess and colluvium and slope alluvium derived from weathered basalt are on canyon walls, mountainsides, foot slopes, slump blocks, ridgetops, and shoulder

Figure 9.-A mantle of loess about 30 inches deep over about 30 feet of glaciofluvial deposits in a road cut. Alluvial sand and gravel flood debris is in the foreground.

slopes. During the Pliocene, the uplifting of the Miocene and Pliocene Columbia River Basalt Group allowed the streams and rivers to form very steep sided and precipitous canyon walls and mountainsides. The basalt is interbedded with strongly oxidized sediments, which in some areas have resulted in the formation of soils with heavier textures. Some remnants of strongly oxidized old river or cataclysmic flood alluvium are at elevations higher than those of the present streams and rivers. These deposits were made long before the dissection to present levels occurred.

The deep dissection of the Columbia River Basalt Group exposed rocks older than the plateau-type basalts. The older rocks include Mesozoic greenstone, limestone, shale, slate, and marine sandstone, and granodiorite. Bolicker, Gwinly, Getaway, Lawyer, Laufer, Lickskillet, and Matheny are examples of soils that formed in colluvium and slope alluvium derived from weathered basalt. The colluvial material has been moved slowly downslope by a combination of gravity and water erosion. Gwinly and Laufer soils, which are Lithic Argixerolls, and Lickskillet soils, which are Lithic Haploxerolls, are mainly on south-facing canyon walls. Bolicker soils, which are Calcic Haploxerolls, Getaway and Lawyer soils, which are Pachic Ultic Argixerolls, and Matheny soils, which are Calcic Pachic Argixerolls, are mainly in areas on north-facing canyon walls where the mantle of loess is thicker and has a relatively high content of volcanic ash.

The development of a mollic epipedon and a cambic or argillic horizon in these soils is the dominant evidence of soil formation. Some of the soils that are in areas where the annual precipitation is 12 to 18 inches and that formed in colluvium derived from calcareous sedimentary rocks and greenstone have a horizon in which secondary carbonates have accumulated or are calcareous throughout. Examples are Schuelke soils, which are Calcic Argixerolls, and Limekiln Variant soils, which are Typic Calcixerolls.

Loess and volcanic ash and slope alluvium derived from weathered basalt are on mountain plateaus, other plateaus, benches, and hillslopes. The uplifting and dissection of the Columbia River Basalt Group resulted in the formation of high plateaus that dip to the northeast. The plateaus have a thin mantle of loess. Local ponding of runoff, intermittent streamflow, and sheetwash have reworked and redeposited the loess.

The Pliocene-age Ringold Formation in the Pasco and Quincy basins is considered to be the major source of loess older than the Channeled Scablands (5, 13, 14). The major sources of post-scabland loess were the lacustrine Touchet Beds, cataclysmic flood deposits, and alluvium along the Columbia and Snake Rivers. This loess contains more volcanic ash and hypersthene than pre-scabland loess.

The survey area is south of the major zone of loess deposition. As a result, the layers of loess are thin and the older layers have remained near the surface, where the soil-forming processes are more active. The loess in this survey area has been under the influence of the soil-forming processes for longer periods than is characteristic in areas where the layers of loess are thick. Soils on mountain plateaus, other plateaus, benches, and hillslopes are very strongly developed, primarily because the older layers of loess are near the surface and because the land surface has been stable and thus has permitted soil formation to continue for long periods.

In areas where the annual precipitation is less than about 18 inches, the development of a mollic epipedon or a cambic, natric, or argillic horizon is the dominant evidence of soil formation. Most of the soils on plateaus in this precipitation zone have a calcic horizon or secondary lime. Calcic Haploxerolls, Calcic Pachic Haploxerolls, and Calcic Pachic Argixerolls are intricately intermingled with Duric Natrixerolls.

The Natrixerolls are mainly on the northern tips of the plateaus. Seasonal cycling of soluble salts upward and downward within the soils and the lateral movement of ground water along the basalt surface may be responsible for the concentration of salts and the development of natric properties in these soils. Basalt surfaces generally are 20 to 80 inches below a thin cap of loess. Soluble salts and calcium carbonates are in the loess or are produced by the weathering of loess and basalt. As the soils form, calcium ions are progressively locked up in the form of very slightly soluble calcium carbonates, which precipitate along the impermeable basalt surface at the base of the soil.

As calcium is progressively taken out of the system, soluble sodium and magnesium salts begin to dominate the chemistry of the soils. As a result, the upper part of these soils have a high exchangeable sodium percentage (ESP). The high ESP levels result in the dispersion of colloids of clay and organic matter in the surface layer. The colloids are then translocated to lower layers. They flocculate as they reach zones of free salts or carbonates. This movement and accumulation of clay and organic matter in the subsoil results in the formation of natric (sodic argillic) horizons. High levels of exchangeable magnesium are considered an adjunct to exchangeable sodium in the development of these soils (18).

Restricted deep percolation of water into the basalt surface results in the formation of calcic horizons along the loess-basalt interface. The calcic horizons have durinodes and discontinuous lenses that are cemented by calcium carbonate and silica. The silica is derived either from the prolonged, slow weathering of feldspars and ferromagnesian minerals or the much more rapid weathering of amorphous material and volcanic glass (11). The degree of silica cementation in the survey area varies because of different amounts of prehistoric volcanic glass that has been retained in the soils from one location to another, variations in the source of the loess or in the basaltic glass at the loess-basalt interface, the lateral movement of silica in ground water along the basalt surface, or variations in the silica caused by differences in the porosity of the basalt. Weissenfels soils, which are Duric Natrixerolls, are an example of soils in which silica cementation has occurred.

In areas where the annual precipitation is more than about 18 inches, the development of a mollic epipedon or an argillic horizon is the dominant evidence of soil formation. Other evidence is the development of a calcic horizon, which has occurred in Neconda soils. Most of the moderately deep and some of the deep soils have a clayey argillic horizon that is montmorillonitic. The argillic horizon apparently is not the result of the weathering of basalt alone because significant amounts of quartz and potassium feldspar indicate that the soils contain loess (9).

The high content of clay in the argillic horizon is the result of long periods of soil formation. A strongly expressed argillic horizon also may result from a greater amount of moisture in areas that are mantled with a thin layer of loess. Basalt acts as a barrier to water movement, and the increased soil moisture probably favors the formation and translocation of clay above the basalt. The restricted movement of bases favors the formation of montmorillonite clay. Neconda soils, which are Calcic Pachic Argixerolls, and Sweitberg soils, which are Pachic Argixerolls, are examples of soils that have an argillic horizon.

Some of the soils at the higher elevations have a mantle of volcanic ash derived from the eruption of Mt. Mazama at Crater Lake, Oregon, about 6,700 years ago. This mantle has been retained because of a dense cover of trees. These soils have an ochric epipedon. Examples are Tolo soils, which are Alfic Vitrixerands, and Olot soils, which are Typic Vitrixerands.

Climate

Climate is an active factor of soil formation. The primary climatic factors are temperature and precipitation. As elevation increases, the amount of precipitation generally increases and the temperature decreases. This survey area is within the rain shadow formed by the Blue Mountains. The northwestern part of the area is more strongly influenced by the rain shadow than the other parts of the area.

Climate affects soil formation through its influence on the rate of weathering, the accumulation and decomposition of organic matter, the degree and kind of leaching, and the degree of erosion. It influences the kind and density of plants that grow in an area. The kind and degree of leaching, or eluviation, depend on the amount of water percolating through the soil under present and past climatic conditions. Percolation is influenced by the amount of precipitation, by the rate of evapotranspiration, and by the length of the frost-free period.

Summers in the survey area are sunny, warm, and dry. Generally, summer precipitation is somewhat ineffective, but occasional thunderstorms can be intense. They are usually of short duration. The thunderstorms at times are accompanied by heavy hail and windstorms.

Winters are moist and are comparatively mild at the lower elevations and cold at the higher elevations. The early and late parts of the growing season are characterized by relatively low soil temperatures, which increase the effectiveness of soil moisture by slowing the rate of evapotranspiration.

In the warmer, drier part of the survey area, the annual precipitation is 12 to 15 inches and the average annual air temperature of about 51 or 52 degrees F. The soils generally are well drained and have a mesic soil temperature regime. The vegetation is dominated by grasses. The soils have a mollic, cambic, natric, or weakly expressed argillic horizon. The mollic epipedon has less organic matter than that in the soils in other parts of the survey area. The precipitation has not been adequate to leach the calcium carbonate from most of the soils. Examples of these soils are Nims and Bolicker soils, which are Calcic Haploxerolls, and Weissenfels soils, which are Duric Natrixerolls.

Generally, as the elevation increases, the annual precipitation increases to 15 to 18 inches and the air temperature decreases to about 48 degrees F. The soils at the higher elevations are mainly well drained and have a mesic temperature regime. The vegetation is dominated by grasses on south-facing slopes and grasses and shrubs on north-facing slopes. The soils have a mollic, cambic, natric, or argillic horizon. The mollic epipedon is thicker and contains more organic matter than that of the soils in the drier areas. The precipitation has not been adequate to leach calcium carbonates from most of the soils, except for some soils on canyon walls and soils that formed in alluvium. Examples of the soils at these elevations are Pataha soils, which are Calcic Pachic Haploxerolls, Thiessen soils, which are Pachic Argixerolls, and Neissenberg soils, which are Duric Natrixerolls.

In areas that receive 18 to 20 inches of annual precipitation, the degree of leaching is greater than it is in areas where the amount of precipitation is lower. The average annual air temperature is about 48 degrees F. The soils are mainly well drained and have a mesic temperature regime. The vegetation is more lush than that in the drier areas. It is dominated by grasses on south-facing slopes and grasses and shrubs on north-facing slopes. The cool temperature results in a lower rate of evapotranspiration, which has made more moisture available for the soil-forming processes. The additional moisture favors the formation and translocation of clay minerals.

The cool temperature slows the decomposition of organic matter and results in a mollic epipedon that is darker and contains substantially more organic matter than that in the warmer areas. In many of the soils, calcium carbonates have been leached from the profile, and in some the average base saturation is less than 75 percent in some part of the upper 30 inches. Most of the soils have a strongly developed argillic horizon. Examples are Powwahkee soils, which are Pachic Ultic Argixerolls, Neconda soils, which are Calcic Pachic Argixerolls, and Mallory soils, which are Pachic Argixerolls.

In areas that receive 20 to 22 inches of annual precipitation, leaching has removed calcium carbonates from the entire profile. The average annual air temperature is about 43 or 44 degrees F. The soils are mainly well drained and have a frigid temperature regime. The vegetation is dominated by grasses and shrubs. The soils have a mollic epipedon that is darker and thicker than that in the drier areas. Some have a base saturation of less than 75 percent in some part of the upper 30 inches. Most have a strongly developed argillic horizon. Examples of these soils are Sweitberg and Snell soils, which are Pachic Argixerolls, and DeMasters soils, which are Pachic Ultic Argixerolls.

In areas that receive 22 to 40 inches of annual precipitation, the vegetation is dominated by trees and shrubs on nearly all of the soils, except for those that are very shallow or shallow and some of those that are moderately deep. The average annual air temperature is about 43 degrees F. The soils have a frigid temperature regime. Most have a mollic epipedon, but the soils that have a mantle of volcanic ash have an ochric epipedon. Nearly all of the soils have an argillic horizon, except for those that formed in thick deposits of volcanic ash. Most of the soils are well drained, but Cloverland soils have a seasonal water table that is perched above a buried subsoil and thus have an albic horizon. Examples of soils in these areas are Cloverland soils, which are Xeric Argialbolls, Getaway soils, which are Pachic Ultic Argixerolls, Olot soils, which are Typic Vitrixerands, and Tolo soils, which are Alfic Vitrixerands.

Past climatic conditions in the survey area, especially during the Pleistocene, favored periods of soil profile development followed by periods of profile destruction or burial. Soil profiles developed during periods when sedimentation or erosion proceeded more slowly than the rate of soil formation. Glacial intervals were periods of soil destruction or burial, and interglacial intervals during the Pleistocene were periods of soil formation (12). The soils in this survey area appear to have been eroded to the depth of resistant horizons, such as a clay-rich B horizon.

Some of the soils have a stone line at the top of a strongly developed Bt horizon or of a Bqk horizon. Examples are Neconda and Weissenfels soils. The long axis of the rock fragments is parallel to the surface of the horizon. This orientation suggests that the stone line is a buried erosion pavement, which originally formed through erosion of fine grained material from slopes. As the slopes were eroded, rock fragments concentrated as lag on the surface.

Some relict soil features reflect more moist climates. Former periods of freezing temperatures resulted in frost sorting and solifluction (15). Solifluction occurs when the ground is frozen part of the year, during which time interstitial ice and lenses of ice form. When they thaw, the soils settle. As they do so, they are displaced downslope. Some soils, such as Matheny soils, have a stone line that could be related to erosion and deposition during periods of solifluction.

Intensive frost action during periods of a periglacial climate was a significant factor in the formation of patterned ground (15). Mounds formed where a previous soil mantle was less than 6 feet thick. These created conditions that favored the formation of ice-wedge polygons. In this survey area the patterned ground that may be attributed to periglacial activity was observed mainly in areas that have soils with a frigid temperature regime. Example of patterned ground are in areas of the Harlow-Snell-Harlow Variant complex, 3 to 30 percent slopes. The Snell soil is on mounds, and the Harlow and Harlow Variant soils are between the mounds.

In uncultivated relict areas in the drier zones, a distinct microrelief may be related to a process other than frost action during periods of a periglacial climate. Natrixerolls in these areas are in circular depressions, and Haploxerolls and Argixerolls are on mounds. In cultivated areas the soil pattern can be inferred from grain height at maturity. The microrelief in uncultivated areas may be associated with the formation of mounds through the retention of loess by shrubs, bushes, or clumps of vegetation. Soils that have a natric horizon formed in the circular depressions. The vegetation on these soils was less dense than that on the mounds. As a result, soil blowing may have removed soil from the depressions, making the microrelief more distinct. This process occurred in areas of Nims-Weissenfels silt foams. Nims soils are on the mounds, and Weissenfels soils are in the circular depressions.

Topography

Topography influences soil formation through its effects on drainage, erosion, soil depth, water infiltration, the microclimate of the soil, and the amount and type of vegetation that grows on the soil. Slope, landscape position, and aspect are important elements of topography.

Much of the water that falls on the surface percolates through the soils, and some of it evaporates. In sloping to steep areas, the runoff rate generally increases with increasing slope. The more water that enters the soil, the greater the depth to which the soil is leached and weathered. Variations in topography result in differences in exposure to the sun and wind and in air drainage. These differences, in turn, can result in important variations in vegetation and soil properties. For example, south-facing slopes receive more direct radiation from the sun than do the north-facing slopes. Consequently, the south-facing slopes are warmer and drier.

Aspect influences the amount of loess that accumulates on the surface. South- and southwest-facing slopes are exposed to the prevailing wind, and the amount of loess that accumulates on these slopes is less than the amount on north-facing slopes. Because of a higher evapotranspiration rate, the south- and southwest-facing slopes support fewer plants than the north-facing slopes. Examples of soils on convex south- and southwest-facing slopes are the shallow Laufer soils. Examples of soils on north-facing slopes are the deep and very deep Matheny soils.

Local relief modifies the moisture regime of soils, especially the soils on flood plains. Runoff from the adjacent upland soils accumulates on the flood plains, and a seasonal high water table is common in some of the soils. Bridgewater Variant and Veazie Variant soils are examples of moderately well drained soils on flood plains. Bridgewater and Veazie are examples of well drained soils on flood plains.

Living Organisms

Living organisms are active in the formation of soils. Plants, micro-organisms, earthworms, and other forms of life are important in determining the rate and direction of soil formation. The accumulation of organic matter, nutrient cycling, profile mixing, and the structural stability of soil aggregates are all made possible by the living organisms in the soil. Furthermore, nitrogen is added to the soil by micro-organisms alone or in association with plants. The kind and abundance of organisms that live on or in the soil at any given location are determined by climate, parent material, topography or relief, and the age of the soil.

Plants provide a cover that helps to control runoff and erosion and helps to stabilize the surface. This stability can have an important bearing on the rate of soil formation. Plant roots penetrate the soil and improve permeability and aeration.

In this survey area the vegetation in the areas of lower precipitation is mainly grasses and shrubs. At the higher elevations, where the amount of effective moisture is highest, the soils have an overstory of coniferous trees and a sparse understory of shrubs, forbs, and grasses.

Different types of plants influence the direction of soil formation, as expressed in the morphological properties of a horizon. Grasses annually contribute considerable quantities of organic material directly to the soil in the form of many fibrous roots. This relatively large amount of organic material decomposes throughout the root zone and forms a thick, dark A horizon.

Trees deposit large quantities of organic material in the form of needles and wood on the surface. This material is decomposed slowly through the action of fungi and other micro-organisms. Thus, soils that form under forest vegetation have a pronounced 0 horizon and generally have a thin, light colored A horizon. Some of the soils that have an overstory of conifers have a thick, dark A horizon. These soils may have supported grasses during drier periods and were invaded by coniferous forests as the climate became cooler and moister. Examples of wooded soils that have a dark A horizon are Getaway and Sweiting soils, which are Pachic Ultic Argixerolls.

Soils that have a mantle of volcanic ash had an overstory of conifers even during the drier periods because the mantle of ash resulted in more favorable moisture conditions. These soils have a thin, light colored A horizon. Examples are Clot soils, which are Typic Vitrixerands, and Tolo soils, which are Alfic Vitrixerands.

Human activities also affect soil formation, especially in areas where forests are cleared and soils are cultivated. Conventional tillage systems alter some soil properties, such as structure and permeability, and in some areas can result in the incorporation of material from a natric horizon into the plow layer. Cultivation can result in a decrease in the content of organic matter and in accelerated water erosion. Logging can alter the surface of the soils and thus also can accelerate water erosion.

Time

Soil formation begins when hard rock is exposed on the earth's surface, alluvial sediments are deposited by floodwater, or a fresh mantle of loess or other regolith is deposited. As soil formation progresses, characteristic soil layers, or horizons, develop. Generally, the greater the number of horizons and the greater their thickness and distinctness, the more mature the soil. The length of time required for soil to form depends on the nature of the parent material and the intensity of the soil-forming factors.

The soils in the survey area formed in material weathered from granodiorite, limestone, shale, slate, and marine sandstone of Mesozoic age (63 to 230 million years ago); in material weathered from basalt of Miocene-Pliocene age (2 to 25 million years ago); in loess older than the Channeled Scablands (more than 16,000 years old); in post-scabland loess (less than 16,000 years old); in colluvium and slope alluvium of pre-Holocene and early Holocene age; in alluvial sand and gravel flood debris from Glacial Lake Bonneville (14,000 to 15,000 years old); in Glacial Lake Missoula glaciofluvial deposits (12,000 to 16,000 years old); and in alluvium and volcanic ash of post-glacial or Holocene age (less than 10,000 years ago).

Primarily because of the stability of the land surface, most of the soils in the survey area have superimposed profiles. These are weathering profiles on older and deeper profiles. They are particularly characteristic of soils on mountain plateaus, other plateaus, benches, and hillslopes.

Superimposed profiles of different ages may be suggested by discontinuities in the soil profile. Neconda soils, for example, are characterized by an abrupt change in texture and color at a depth of about 15 to 30 inches and in some pedons have a stone line at this depth. These soils have a Bt horizon because they are in areas that receive the higher amounts of precipitation, which favor the formation of a Bt horizon. Nims, Pataha, Neissenberg, and Weissenfels soils are characterized by an abrupt change and a stone line at the top of a Bqk horizon, at a depth of about 23 to 34 inches. Less obvious discontinuities in the soils of the survey area may indicate superimposed profiles of different ages.

Most of the soils on the flood plains, alluvial fans, and low terraces are young. Soils that formed in Holocene-age alluvium show little evidence of profile development other than the accumulation of organic matter in the surface layer. Bridgewater and Veazie soils, which are Cumulic Haploxerolls, are examples.

Soils on terraces and terrace escarpments formed in

Glacial Lake Bonneville and Glacial Lake Missoula flood deposits. They have had enough time for the formation of a mollic epipedon through the accumulation of organic matter and for the formation of a cambic horizon through leaching of calcium carbonate downward. In some areas these soils have a zone of calcium carbonate accumulation below the cambic horizon. Chard soils, which are Calcic Haploxerolls, and Dallesport soils, which are Typic Haploxerolls, are examples.

Soils on canyon walls, mountainsides, foot slopes, slump blocks, ridgetops, and shoulder slopes have had enough time for the formation of a mollic epipedon and a cambic or argillic horizon. Soils that have a cambic horizon are mainly in the drier areas. Gwinly soils, which are Lithic Argixerolls, and Lickskillet soils, which are Lithic Haploxerolls, are examples.

Soils on mountain plateaus, other plateaus, benches, and hillslopes are more strongly developed than soils on other landforms, mainly because of the stability of the land surface in these positions. This stability has resulted in longer periods for soil formation to take place. The development of a mollic epipedon and a natric, argillic, or cambic horizon is the dominant evidence of soil formation in these soils. Weissenfels soils, which are Duric Natrixerolls, and Neconda soils, which are Calcic Pachic Argixerolls, are examples.

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Glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial cone. The material washed down the sides of mountains and hills by ephemeral streams and deposited at the mouth of gorges in the form of a moderately steep, conical mass descending equally in all directions from the point of issue.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal-unit-month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Annual cropping. Harvesting an irrigated or nonirrigated crop, including grasses and legumes, each year. The crop is planted or seeded in spring or fall. Rotations that include summer fallow are not considered annual cropping.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A mineral soil horizon that is characterized by the illuvial accumulation of layer-lattice silicate clays. The argillic horizon has a certain minimum thickness, depending on the thickness of the solum; has a minimum content of clay in comparison with an overlying eluvial horizon, depending on the clay content of the eluvial horizon; and generally has coatings of oriented clay on the surface of pores or peds or bridging sand grains.

Ash, volcanic. Fine pyroclastic material less than 4.0 millimeters in diameter; in *Soil Taxonomy* ash is less than 2.0 millimeters in diameter.

Arroyo. The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as

Very low	0 to 2
Low	2 to 3.75
Moderate	3.75 to 5
High	5 to 7.5
Very high	more than 7.5

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Bajada. A broad alluvial slope extending from the base of a mountain range out into a basin and formed by coalescence of separate alluvial fans.

Basal area. The cross-sectional area of a tree bole measured at 4.5 feet above ground level. It is generally expressed in square feet of cross-sectional area per acre.

Basalt. A dark or moderately dark, commonly extrusive (locally intrusive, as in dikes), mafic igneous rock composed chiefly of calcic plagioclase (generally labradorite) and clinopyroxene in a glassy or fine grained groundmass; the extrusive equivalent of gabbro.

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench. A platform-type, nearly level to gently inclined erosional surface developed on resistant strata in areas where valleys are cut in alternating strong and weak layers that are essentially horizontal. Structural benches, in contrast to stream terraces, have no geomorphic implication of former partial erosion cycles and base-level controls, nor do they represent a stage of flood-plain development following an episode of valley trenching.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep or very steep broken land at the border of an upland summit that is dissected by ravines.

Breast height. An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Brush management. Use of mechanical, chemical, or biological methods to reduce or eliminate competition of woody vegetation. Control of this vegetation allows understory grasses and forbs to recover or makes conditions favorable for reseeding. It increases forage production and thus reduces the hazard of erosion. Brush management may improve the habitat for some species of wildlife.

Buried. Pertaining to paleosols, landforms, and geomorphic surfaces covered by a mantle of geologic material (e.g., sedimentary or volcanic material).

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion or an exposed volcanic neck.

Cable yarding. A method of moving felled trees to a nearby central area for transport to a processing facility. Most systems include a drum, a pole, and wire cables and involve the same principle as that of a rod and reel for fishing. To reduce friction and surface disturbance when the felled trees are yarded or reeled in, one end of the trees generally is lifted off the ground or the trees are completely suspended.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Calcic horizon. A subsurface horizon, more than 6 inches thick, that has more than 15 percent calcium carbonate equivalent and at least 5 percent more carbonates than the C horizon.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Cambric horizon. A subsurface horizon that has textures finer than loamy fine sand and in which materials have been altered or removed but not accumulated. Evidences of alteration include the elimination of fine strata; changes caused by wetness, such as gray colors and mottles; redistribution of carbonates; and colors that are yellower or redder than those in the underlying horizons.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Canyon. A long, deep, narrow, very steep-sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Cement rock. Shaly limestone used in the manufacture of cement.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation by applications of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Cirque. Semicircular, concave, bowllike areas that have steep faces primarily resulting from glacial ice and snow abrasion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax plant community. The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed.

Clod. A compact, coherent mass of soil ranging in size from 5 or 10 millimeters to as much as 8 or 10 inches; produced artificially, usually by such activities as plowing or digging, especially on soils that are either too wet or too dry for conventional tillage.

Coarse fragments. Mineral or rock particles larger than 2 millimeters in diameter.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. The content of these fragments is 35 to 60 percent in very cobbly soil material and more than 60 percent extremely cobbly soil material.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concentrated flow erosion. A form of channel erosion that occurs on cropland and is obliterated by tillage each year. It is sometimes referred to as "ephemeral gully erosion." It occurs in depressional areas of natural drainage or runoff networks.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Congeliturbate. Soil material disturbed by frost action.

Conglomerate. A coarse grained, clastic rock composed of rounded to subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. If soil-improving crops and practices used in the system more than offset the soil-depleting crops and practices, then it is a good conservation cropping system. Cropping systems are needed on all tilled soils. Examples of soil-improving practices in a conservation cropping system are crop rotations that include grasses and legumes and the return of crop residue to the soil. Other practices include green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are

Loose.-Noncoherent when dry or moist; does not hold together in a mass.

Friable.-When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump. *Firm.-When* moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.-Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger. Sticky.-Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.-When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.-When dry, breaks into powder or individual grains under very slight pressure.

Cemented.-Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coppice dune. A small dune of fine grained soil material stabilized around shrubs or small trees.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system. Growing crops using a planned system of rotation and management practices.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope of the land.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cuesta. An asymmetric, homoclinal ridge capped by resistant rock layers of slight to moderate dip.

Culmination of mean annual increment (CMAI). The average yearly volume growth of a stand of trees from the year of origin to that age which gives the highest average. The CMAI for a particular species is based on the applicable yield table publication and is calculated according to those volumes given for the smallest size.

Cutans. A modification of the texture, structure, or fabric of natural surfaces in soil material through the concentration of particular soil constituents or in situ modification of the plasma. Cutans can be made up of any of the component substances of the soil material.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Delta. A body of alluvium that has a nearly flat and fan-shaped surface, deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Desert pavement. A layer of gravel or coarser fragments on a desert soil surface that was emplaced by upward movement of fragments from underlying sediment or remains after finer particles have been removed by running water or wind.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming with the dip of underlying bedded rock.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is used for a close-growing crop that provides protection against erosion, and the other strip is used for a crop that provides less protection. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized: *Excessively drained.-These* soils have very high and high hydraulic conductivity and low water-holding capacity. They are not suited to crop production unless irrigated. *Somewhat excessively drained.-These soils* have high hydraulic conductivity and low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low. *Well drained.-These* soils have intermediate water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season for yields to be reduced. *Moderately well drained.-These soils* are wet close enough to the surface or long enough for planting or harvesting to be delayed or yields of some field crops to be reduced unless an artificial drainage system is provided. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.-These soils are wet close enough to the surface or long enough for planting or harvesting to be delayed or crop growth to be markedly restricted unless an artificial drainage system is provided. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained.-These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained.-These soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except for rice) unless an artificial drainage system is provided.

Drainage, surface. Runoff, or surface flow of water, from an area.

Draw. A small stream valley, generally more open and with broader bottom land than a ravine or gulch.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Durinodes. Weakly cemented to indurated soil nodules cemented with silica dioxide. Durinodes break down in concentrated KOH after treatment with HCI to remove carbonates, but they do not break down on treatment with concentrated HCI alone.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep. *Erosion* (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature; for example, fire that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and produced by erosion or faulting. Synonym: scarp.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fallow. Cropland left idle for at least one growing season to control weeds and to provide adequate seed zone moisture for early fall seeded grains. Fallow is common in regions of limited rainfall where cereal grain is grown.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fill slope. *A* sloping surface in an area of excavated soil material from a road cut; generally on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, and clay.

Firebreaks. Spaces cleared of flammable material to stop or check creeping of running fires. They also serve as a line from which to facilitate the movement of equipment in fire suppression. Most roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material is 35 to 60 percent flagstones, and extremely flaggy soil material is more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (or 300 meters) and fringes a mountain range or high-plateau escarpment.

Foot slope. The geomorphic component that forms the inner gently inclined surface at the base of a hillslope or canyon wall. The surface profile is dominantly concave; in terms of gradational processes, it is a transition zone between upslope sites of erosion (back slope) and downslope sites of deposition (toe slope).

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. *All* trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. *A* stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols-clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Greenstone. An old field term applied to any compact, dark green, altered, basic to ultrabasic igneous rock (e.g., spilite, basalt, gabbro, diabase, and serpentinite) owing its color to the presence of chlorite, hornblende, and epidote and commonly found in folded mountain ranges.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard rock. Rock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head out. To form a flower head.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops. Crops such as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well-defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Hillslope. The steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of the hill. In descending order, geomorphic components of a simple hillslope may include shoulder slope, back slope, foot slope, and toe slope. All of these components, however, are not necessarily present in any given hillslope continuum. In addition, complex hillslopes may include two or more sequences from back slope to toe slope.

Holocene. The second epoch of the Quaternary Period of geologic time, extending from the end of the Pleistocene Epoch (about 10,000 years ago) to the present; also the corresponding (time-stratigraphic) "series" of earth materials. Synonyms: Recent, postglacial.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons are as follows:

O horizon.-An organic layer of fresh and decaying plant residue.

A horizon.-The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.-The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

E horizon.-The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

C horizon.-The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the number 2 precedes the letter C.

R layer.-Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate;

the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are-

Border.-Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.-Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.-Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.-Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).-Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.-Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.-Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.-Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.-Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Limestone. A sedimentary rock consisting chiefly (more than 50 percent by weight or by area) percentages under the microscope) of calcium carbonate, primarily in the form of the mineral calcite, with or without magnesium carbonate; specifically a carbonate sedimentary rock containing more than 95 percent calcite and less than 5 percent dolomite.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-residue crops. Crops such as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Mean annual increment. The average yearly volume growth of a stand of trees from the year of origin to the age under consideration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mesa. A broad, nearly flattopped and commonly isolated upland mass characterized by summit widths that are more than the heights of bounding erosional scarps.

Mesozoic. The era of geologic time from the end of the Paleozoic to the beginning of the Cenozoic (about 63 to 230 million years ago).

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miocene. An epoch of the upper Tertiary Period (about 10 to 25 million years ago), after the Oligocene and before the Pliocene; also, the corresponding worldwide series of rocks. It is sometimes considered to be a period, when the Tertiary is designated as an era.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Mollic epipedon. A surface horizon that is dark colored, contains more than 1 percent organic matter, and is generally more than 7 inches thick. It has more than 50 percent base saturation and is not both hard and massive when dry. Dark colors have Munsell values darker than 3.5 when moist and 5.5 when dry and Munsell chromas of less than 3.5 when moist and have such common soil color names as black, very dark brown, very dark gray, and *very* dark grayish brown.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of these horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance-few, *common,* and *many; size-fine, medium,* and *coarse;* and contrast-faint, *distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1;000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides and considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Mountainside. A part of the mountain between the summit and the foot.

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of the three simple variables-hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Natric horizon. A subsurface horizon that is a special kind of argillic horizon, containing much exchangeable sodium.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Ochric epipedon. A surface horizon that is too light in color (having a higher value or chroma than a mollic epipedon), too low in content of organic matter, or too thin to be either a mollic or an umbric epipedon.

Observed rooting depth. Depth to which roots have been observed to penetrate.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Paralithic contact. As used in the soil classification system of the National Cooperative Soil Survey in the United States, the boundary between soil and continuous coherent underlying material that has a hardness of less than 3 (Mohs scale).

Parent material. The unconsolidated organic and mineral material in which soil forms.

Patterned ground. A term for the more or less symmetrical forms, such as circles, polygons, nets, stripes, garlands, and steps, that are characteristic of, but not confined to, mantles subjected to intensive frost action, as in periglacial environments. Stone polygons generally form on slopes of less than 8 percent, while garlands and stripes form on slopes of 8 to 15 percent and more than 15 percent, respectively. "Fossil patterned ground" is now inactive. It is a relict of the colder periods during the Pleistocene when a region was under periglacial conditions.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permafrost. Layers of soil, or even bedrock, occurring in arctic or subarctic regions, in which a temperature below freezing has existed continuously for a long time.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitting (in tables). Pits caused by melting around ice. They form on the soil after plant cover is removed.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with a relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Playa. The generally dry and nearly level lake plain that occupies the lowest parts of closed depressional areas, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff.

Pleistocene. The first epoch of the Quaternary Period of geologic time (approximately 2 million to 10,000 years ago); following the Tertiary Pliocene Epoch and preceding the Holocene.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Pliocene. The last epoch of the Tertiary Period of geologic time (approximately 7 to 2 million years ago); following the Miocene Epoch and preceding the Quaternary Pleistocene Epoch; also the corresponding (time-stratigraphic) "series" of earth materials.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Post and piling outlet. A market location where posts and pilings are bought, processed, and sold.

Potential native plant community. The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed. (See Climax plant community.)

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. The application of fire to land under such conditions of weather, soil moisture, and time of day as presumably will result in the intensity of heat and spread required to accomplish specific forest management, wildlife, grazing, or fire hazard reduction purposes.

Pressure pan. A subsurface horizon or soil layer having a high bulk density and lower total porosity than the layer directly above or below it as a result of pressure applied by normal tillage operations or by other artificial means. Frequently referred to as *plowpan, plow sole, tillage pan,* or *traffic pan.*

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This increases the vigor and reproduction of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Puddling. The process by which a soil loses its structure and becomes massive. It is caused by traffic or tillage during wet periods. The soil becomes hard and cloddy when it dries.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Red beds. Sedimentary strata mainly red in color and composed largely of sandstone and shale.

Reforestation. The establishment of planted or naturally occurring tree seedlings in an area that was once forested; also includes the physical acts associated with planting tree seedlings in the ground. The expected period needed for natural reforestation is described by the terms readily, periodically, and infrequently. *Readily* indicates that seedlings are expected to occupy the area in 2 to 5 years; *periodically,* in 5 to 10 years; and *infrequently,* in 10 to 20 years.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Ridge. A long, narrow elevation of the land surface, generally having a sharp crest and steep sides and forming an extended upland between valleys. The term is used in areas of both hill and mountain relief (less and greater than 300 meters).

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables). Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. A medium grained, clastic sedimentary rock composed of abundant and rounded or angular fragments of sand size set in a fine grained matrix (silt or clay) and more or less firmly united by a cementing material (commonly silica, iron oxide, or calcium carbonate); the consolidated equivalent of sand, intermediate in texture between conglomerate and shale.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shoulder slope (hillslope). The transition zone from the back slope to the summit of an upland. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site class. A grouping of site indexes into 5 to 7 production capability levels. Each level can be represented by a site curve.

Site curve (50 year). A set of related curves on a graph that shows the average height of dominant trees for the range of ages on soils that differ in productivity. Each level is represented by a curve.

The basis of the curves is the height of dominant trees that are 50 years old or are 50 years old at breast height.

Site curve (100 year). A set of related curves on a graph that show the average height of dominant and codominant trees for a range of ages on soils that differ in productivity. Each level is represented by a curve. The basis of the curves is the height of dominant and codominant trees that are 100 years old or are 100 years old at breast height.

Site index. A numerical index equal to the height that dominant or dominant and codominant trees reach at a specific age, usually 50 or 100 years. This index, the age of the stand of trees, and the appropriate yield table publication are used in determining yields.

Skid trails. The paths created by skidding logs and the bulldozer or tractor used to pull them.

Skidding. A method of moving felled trees to a nearby central area for transport to a processing facility. Most systems involve pulling the trees with wire cables attached to a bulldozer or rubber-tired tractor. Generally, one end is lifted when the felled trees are skidded or pulled. As a result, friction and surface disturbance are minimized.

Slate. A compact, fine grained, metamorphic rock formed from such rocks as shale and volcanic ash. It is characterized by fissility along planes independent of the original bedding (slaty cleavage), whereby they can be parted into plates that are lithologically indistinguishable.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil generally is silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized:

Nearly level..0 to 3 percent
Gently sloping ....3 to 5 percent
Sloping..5 to 10 percent
Strongly sloping ....10 to 15 percent
Moderately steep ....15 to 30 percent
Steep ....30 to 45 percent
Very steep ....45 percent and higher

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slope alluvium. Sediment gradually transported on mountainsides or hillslopes primarily by alluvial processes and characterized by particle sorting. In a profile sequence, sediments may be distinguished by differences in size or specific gravity of coarse fragments and may be separated by stone lines.

Sloughed till. Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Slump block. The mass of material torn away as a coherent unit during a block slump. It may be as long as 2 kilometers and as thick as 300 meters.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na+ to Ca' + Mg''. The degrees of sodicity and their respective ratios are-

Slight.. less than 13:1
Moderate 13-30:1
Strong ....more than 30:1

Soft rock. Rock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solifluction. Slow viscous downslope flow of water-saturated regolith; especially the mass-wasting process occurring in areas of frozen ground, with alternate freezing and thawing of surficial materials.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stand density. The degree to which an area is covered with living trees. It is generally expressed in units of basal area per acre, number of trees per acre, or percentage of ground covered by the tree canopy as if viewed from above.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 6 to 15 inches (15 to 38 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure *are-platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Tail water. The water just downstream of a structure.

Talus. Rock fragments of any size or shape, commonly coarse and angular, derived from and lying at the base of a cliff or very steep, rock slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Terrace escarpment (terrace slope). The scarp or bluff below the outer edge of a terrace; the' front or face of a terrace.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow hazard. The likelihood that trees will be blown over by the wind and partially or completely uprooted. The predicted severity of windthrow is described by the terms occasionally and frequently. *Occasionally* means that as much as 5 percent of the trees in a stand may be blown down during periods of excessive wetness and moderate or strong winds. The hazard of windthrow is moderate. *Frequently* means that more than 5 percent of the trees in a stand may be blown down during periods of excessive wetness and moderate or strong winds. The hazard of windthrow is severe.

Yarding paths. The paths created by cable-yarded logs as they are pulled up or down a hill to a nearby central area.